

Railway Mechanical Engineer

Vol. 102

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No. 5

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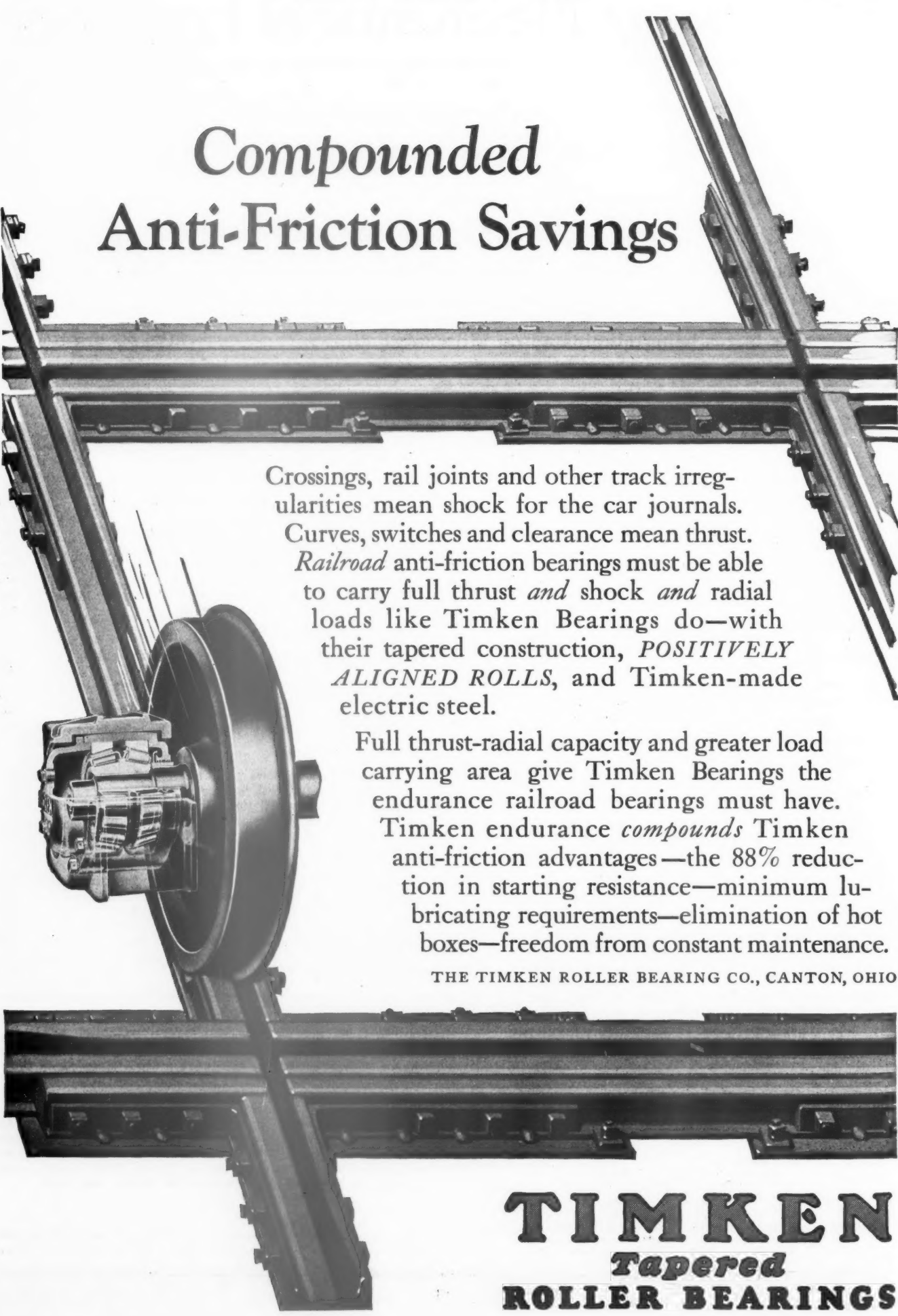
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THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

TIMKEN
Tapered
ROLLER BEARINGS

Railway Mechanical Engineer

Vol. 102

May, 1928

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The railroads of the United States, during 1927, retired a total of 91,435 box cars, furniture cars and automobile cars. According to common practice, after the trucks are removed, the superstructures of many such cars are burned. This method of destruction permits the

**Why burn
retired
freight cars?**

owner to obtain a return only on the scrap value of the metal parts attached to the wood car body. None of the metal fittings or fixtures can be reused as the heat of the fire has destroyed their utility. Much of the lumber and metal parts can be saved if the cars are dismantled instead of burned. A mid-western road has been for the past two years, dismantling its cars and saving enough material to pay for the labor charges. A large portion of the lumber and a lot of the metal parts have been salvaged and put back in use. Some of this material is used by the car department, some goes to the bridge and building department, or it is used for making ties for yard tracks, or goes to the stores department for use in other departments. During the Summer months, the average consumption, on this road, of second-hand lumber from old cars runs around 110,000 to 125,000 board feet per month. Why burn the old cars and buy this much more new lumber?

In the effort to facilitate repairs to equipment and improve the efficiency of shop operations, most railroads in recent years have been making a careful survey and study of their machine tools and shop equipment. As a result, improvement programs have been mapped out, many of

**More modern
machine tools
needed**

them extending over a period of several years, and the railroads have thus afforded a good market for such equipment at a time when the machine tool business was at a low ebb, except for automobile building requirements. A typical instance of what the railroads have been doing is that of a road less than 500 miles in length, which when it completes its shop equipment rehabilitation program within the next year, will have expended about a half million dollars over a four-year period. There is still, however, a great amount of obsolete equipment in railroad shops which cannot be operated efficiently and should be replaced. Is there any justification, for instance, in having tools more than 50 years of age still in operation? There are many such!

Up to about 150 years ago industrial operations were performed with hand craft tools. The development of the steam engine was delayed in its earlier stages due to the lack of adequate tools. It was impossible, for instance, to turn rods or bore cylinders with any degree

of accuracy. The nineteenth century was marked by a rapid development and improvement in machine tools, both as to accuracy of work, size and convenience of operation.

During the early part of the twentieth century machine tool operation was revolutionized by the introduction of high speed cutting steels and the individual motor drive. The result, so far as machine tool design was concerned, was startling. The increase in the size and intricacy of locomotive parts during the past quarter century has been almost as noteworthy. With these things in mind, to what extent, if at all, can tools which were installed in railroad shops more than 25 years ago be justified? The question is a challenging one. Obviously there are some places where the amount and kind of work to be done may justify the retention of some of the older tools, but is it not true that too many such tools are now to be found in places where they are giving far from efficient and economical service?

Many motive power officers have shown a keen interest in the development of the spot system of repairing locomotives which was first placed

The spot system in operation at the Mt. Clare, (Baltimore, Md.), shops of the Baltimore & Ohio several years ago, and more recently installed in the Elizabethport, N. J., shops of the Central Railroad of New Jersey. The successful operation of the spot system appears to depend on two factors: First, the erecting shop must have longitudinal tracks and second, the work of stripping must be done off the erecting floor.

This last factor, however, contains a number of features that are worth serious thought on the part of those operating shops with transverse tracks. Erecting, according to Webster's dictionary, means to put together for use; to set up. That is what the erecting shop is used for in other industries, such as the automobile or engine building. Of course, manufacturing industries do not have the problem of tearing down before they can start the work of assembling. Railroad shops do have that problem and it is the usual practice to find the work of stripping performed on the same floor with that of erecting. Moving the scrap and parts to be repaired away from the erecting floor without disturbing the work of assembly, is always a difficult problem.

Stripping locomotives outside the shop or away from the erecting floor is a logical development in locomotive repair work. The fact that shops having transverse tracks must necessarily use a transfer table to get locomotives into the shop, should not be a serious handicap

in making the erecting shop strictly an assembly department. As was shown in an article published in the March, 1928, issue of the *Railway Mechanical Engineer*, page 158, the Central Railroad of New Jersey uses a transfer table at Elizabethport in routing its locomotives from the stripping tracks to the erecting shop. Keeping the stripping work away from that of assembling means a clear floor for production and safer working conditions, and simplifies the routing and handling of material. There are, undoubtedly, many shops with transverse tracks that could obtain better production if the work of stripping was conducted in a department separate from that of erecting. Here is one feature of the spot system that seems to have possibilities of general application, to a variety of shop layouts.

The men responsible for the early development of the steam locomotive were practical men of great native

The A B C's of locomotive design ability. They tackled each step with the idea of making something that would work rather than explaining how or why it worked. The great locomotive builders from Stephenson down to comparatively recent years, were practically forced to concentrate on developing and applying principles and this kept them so busy that they had scant time or desire to explain them.

It was realized, however, early in railroad history that the successful performance of a locomotive depended on properly balancing the boiler, cylinders and tractive force. For a number of years, designers and builders were able to obtain the desired increase in power delivered by sheer increase in size. But it was not long until difficulties were encountered with clearance and weight limitations. It was in this period of the final development of the saturated steam locomotive and the beginning of the superheated steam locomotive that F. J. Cole worked out his system of basic ratios on which much of recent design has been founded. Those familiar with Mr. Cole's work, will agree when we say that his system of basic ratios was the beginning of a new era in locomotive design and was also the foundation for most of the progress that has been accomplished since that time.

Essentially, Cole's ratios base locomotive design on three things; namely, steam consumption per cylinder horsepower-hour, coal consumption per cylinder horsepower-hour, and maximum cylinder horsepower. These three fundamentals are often referred to as the A B C's of locomotive design and they are the principal factors on which the real design is based. There are some designers who believe that Mr. Cole made a fundamental error when he assumed that there is a fixed physical limit to the work which the cylinders will do. From the results obtained with power of recent construction, we know that the cylinders will do more work if they are supplied with steam at higher pressures and temperatures. Cole's figures for superheated steam consumption per cylinder horsepower-hour is 20.8 lb. and his figure for coal consumption is 3.25 lb. These figures are still being used as the correct marks to shoot at, notwithstanding the changes which have taken place in superheater design, the advent of the feed-water heater, etc.

C. A. Brandt in his paper before the Canadian Railway Club, the final installment of which appears elsewhere in this issue, shows quite clearly that there is a

real need for a revision of Cole's standard ratios. Mr. Brandt states that with a Type E superheater we may safely expect a steam consumption of 17.5 lb. per cylinder horsepower-hour. This represents a reduction of nearly 16 per cent from Cole's figure. Mr. Brandt does not give a fixed figure of what may be expected in the way of coal consumption, but he has shown in several instances that this is about 2 lb. This, compared with Cole's figure of 3.25 lb., is a reduction of over 38 per cent.

These are only two instances among a number of radical variations between Cole's figures and those actually obtained in modern locomotive practice that are discussed in Mr. Brandt's paper. There is no reason why a new set of standard ratios can not be worked out. In all probability, if this is done, and it should be done, locomotive designers will be using a figure for cylinder horsepower from 25 to 30 per cent greater than that calculated by Cole's formula.

Shop supervisors quite often harbor a feeling that when requesting new machine tools they must ask for about twice as much as they need in order to get what

**Do you
get what
you want?**

they really want. No doubt this attitude has been created in many cases by the knowledge that here and there in certain departments are obsolete machines for which a replacement machine has been requested year after year without success. The officer who controls the expenditures for new equipment is continually faced with the responsibility of justifying every dollar spent and it would be a poor executive indeed who would authorize an expenditure just because someone thought a machine ought to be replaced on account of obsolescence. That isn't reason enough these days. The present tendency in shop layout is to departmentalize the work, each section being supplied with machines to handle the entire volume of work assigned to it. For this reason a new machine should be looked upon not as an individual unit but in its relation to other machines in the section. In many cases a single modern machine with modern tooling equipment will replace two older machines and make possible a substantial reduction in output time and in production cost. Therefore, the first requisite in selecting machinery should be a definite plan of building the machine equipment around a known quantity—the volume of work required. If a single machine in a group is incapable of delivering finished material on an equal basis with the others this is the machine that must be replaced whether it is 20 years old or comparatively new, and this fact provides a logical reason for its replacement. A machine which holds back others is costing the company real money, and if this cost is known it is a simple matter to determine how long it will take a new machine to pay for itself or how much will be saved by its installation.

The man who is most concerned with the necessity for new machinery in a shop quite often defeats his own efforts to get new equipment by not taking the trouble to do a thorough job of asking for it. There are three important factors involved in making a request; first, have a definite plan of machine tool selection—this will provide the reason for making the purchase; second, know the total cost of the installation, so that the man higher officer will know how much money to ask for and, third, determine beyond rea-

sonable doubt the savings that may be anticipated. When this is done it puts the responsibility up to the man at the top and, as a rule, he has to have an exceptionally good reason for declining to save money for the company.

It is doubtful whether many roads have any system of records to show a complete history of the performance of each machine tool during its service life. Without such records, how is a railroad to know that a machine tool is rendering satisfactory service? How can a master mechanic or shop superintendent determine to what machines different kinds of work should be assigned for economical production, or when a machine should be transferred to another department or shop where production is not an important factor?

Keep a record of machine tool performance

The general superintendent of a large industrial plant in which experimental work is carried on, thus necessitating a line of machine tools to handle job work, has worked out a system of records from which data can be quickly secured to answer such questions. Before developing a system to determine the number of dollars spent on each tool during its life, this superintendent first established what constituted the causes for expenditures. The causes were divided into five classifications: First, carelessness or ignorance on the part of the operator; second, the wrong kind of material may be used in the machine, either as originally built or in replacements; third, lack of proper lubrication, whether due to poor design, or the lack of the operator's attention; fourth, improper tooling or the use of inferior cutting tools; fifth, the application of the work to the machine, overload, etc.

Every machine in this plant is numbered and indexed so that a check upon it can be made at any time. Once every five years the whole record is gone over and a study made of the tools taken out of service, to see why they were taken out and how much was spent on each of them. The records show how long they were in service, whether or not they were on night or day work, the type of operator assigned to them, and whether they were doing fine or rough work. With this information this superintendent is in a position to arrive at a sound rate of depreciation for other tools of the same type.

In addition, attached to the records are time studies for doing different jobs on different makes and types of machines. These records often show that it is more economical to transfer a job to a different type or make of machine. Furthermore, when a new machine is purchased, by referring to the time study records, it can be quickly determined what jobs are best suited for the new machine, thus eliminating a considerable amount of guess work. This superintendent has even gone so far as to try the workmen on different types of machines to determine which machine they can operate to the best advantage. He has paid particular attention to the compilation of data pertaining to the life of a machine. This information determines whether a machine should be scrapped on account of obsolescence, or should be transferred to another shop where the service is less severe. This particular data shows for each tool, whether or not the repairs are too frequent and costly, resulting in repeated periods of idleness.

This system also reveals definite indications of the quality of the design and of the construction weak-

nesses, if any, of each tool. This aids in deciding from what builders to purchase machine tools in the future.

In railway practice, the shop foreman generally has most of the information in his head. This information should be in record form for ready reference by the officer who makes recommendations to the management for the purchase of machine tools and who also is responsible for the economical production and the expenditures for the maintenance of machine tools.

New Books

PROFITABLE APPLICATION OF ELECTRIC TRUCKS AND TRACTORS IN INDUSTRY. Published by The Society for Electric Development, Inc., 420 Lexington Avenue, New York. 90 pages, illustrated. Price \$1.00.

This handbook, published by The Society for Electrical Development in co-operation with 20 manufacturers of electrical industrial trucks and tractors, storage batteries and accessories, deals with the efficiency and economy of the electric truck and tractor in industry. It is based on a survey of 200 typical plant operations made by a member of the Survey Committee of the American Society of Mechanical Engineers, and contains a special chapter for each of 16 major industries. Operating processes and the particular type of truck suited to individual jobs are described, and data given on operating costs and the direct savings effected by the use of this type of equipment.

BLUE PRINT READING. By Thomas Diamond, associate professor of vocational education at the University of Michigan, Ann Arbor, Mich. 70 pages, 5 in. by 9 in., bound in paper. Published by the Bruce Publishing Company, Milwaukee, Wis. Price 48 cents per single copy.

This book is a primer on blue print reading that has been prepared to give students in industrial arts work a working knowledge of how to read blue prints. It is divided into two parts. Part I provides a series of mechanical drawings which the learner is asked to interpret by answering questions concerning dimensions, construction, relation, etc., of the objects shown. The drawings illustrate the common conventions of drafting, in increasing difficulty and complicated form. Part II applies the principles learned in Part I in a series of dimensioned perspective sketches and incomplete projection drawings which the student completes by supplying missing views, dimensions, etc.

PROCEEDINGS OF THE INTERNATIONAL RAILWAY MASTER BLACKSMITHS' ASSOCIATION. 147 pages, illustrated. 6 in. by 8½ in. Published by the association, William J. Mayer, secretary-treasurer, 2347 Park Avenue, Detroit, Mich.

This is the proceedings of the thirty-first annual convention of the International Railroad Master Blacksmiths' Association which was held at the Hotel Lafayette, Buffalo, N. Y., August 16 to 18, 1927, inclusive. It contains complete reports of the papers and discussions on the following subjects: Autogenous welding, carbon and high-speed steel, tools and formers, drop and machine forgings, drawbars and drawbar pins, frame making and repairing, heat treatment of iron and steel, reclamation, spring making and repairing, and safety first.



Two-unit gas-electric car which is operated on the New York Central

Gas-electric unit for rail cars

High compression, compact engine operated at full torque at varying speeds
—Cooling system and electrical control carefully worked out

COMPACTNESS without sacrifice of availability, operation at full throttle and open governor at a wide range of engine speeds, interchangeability of the unit and unique electrical control, are the important features of the gas-electric unit designed and put in service by the Mack International Motor Company, Plainfield, N. J. The equipment has been designed for use in three sizes of rail motor cars and three sizes of locomotives. It also has been installed in a motor coach. A single-unit car has been in operation on the line of the Winnipeg River Railway, and a two-unit car has been in service on the New York Central in the Adirondack Mountains in northern New York. These cars are shown in the illustrations.

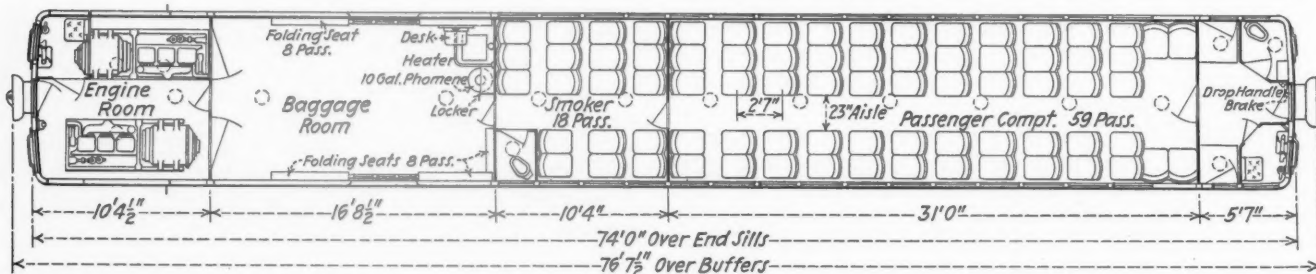
Construction of the base

The engine and generator, together with all auxiliaries, weighs 5,700 lb. It was important that this weight be supported on a base that would provide rigidity and

illustrations, each consists of two rubber blocks held in compression between two metal plates by two bolts. Each bottom base plate is bolted to the car floor. The power unit base pad rests on the lower rubber block and the second rubber block rests on top of the pad. The whole is locked in position by two bolts, the castellated nuts of which are tightened against ball joint washers, permitting universal angular movement of the bolt. The floating bolts and rubber blocks not only absorb vertical vibrations, but also horizontal end thrusts imposed on the unit.

Features of the engine

The six-cylinder Mack AP model engine used, has a 5-in. bore and 6-in. stroke with a total piston displacement of 707 cu. in. Referring to the power curve chart, at 1,350 r.p.m. the engine develops 125 brake horsepower and at 1,800 r.p.m., 152 brake horsepower. At 1,350 r.p.m., 103.5 lb. brake m.e.p. is attained, which is



Floor plan of a two-unit gas-electric car

proper alinement. The conventional cast base did not prove satisfactory as it is subjected to warping, which prevented proper alinement and did not provide accessibility to the crank case. As shown in the illustration, a base constructed of channels was finally adopted. This design permitted the removal of the crank case and generator without the necessity of removing the unit from the car. It also provided greater rigidity and made possible accurate alinement.

The unit rests on four rubber cushions for the purpose of absorbing the engine vibrations and to relieve the impact caused by starting and stopping and coupling cars. These rubber cushions, shown in one of the il-

lustrations, each consists of two rubber blocks held in compression between two metal plates by two bolts. This output is obtained by using the average grade of gasoline.

The piston heads are made of aluminum and have long skirts to provide for adequate lubrication of the cylinder walls and to distribute the lateral piston load against the cylinder walls over a maximum area. The connecting rods are of tubular construction machined all over. This design was adopted to provide adequate strength with light weight and to facilitate close balancing. The cast-in-block cylinders are provided with aluminum cylinder heads, one for each pair of cylinders. Aluminum was used primarily to effect a

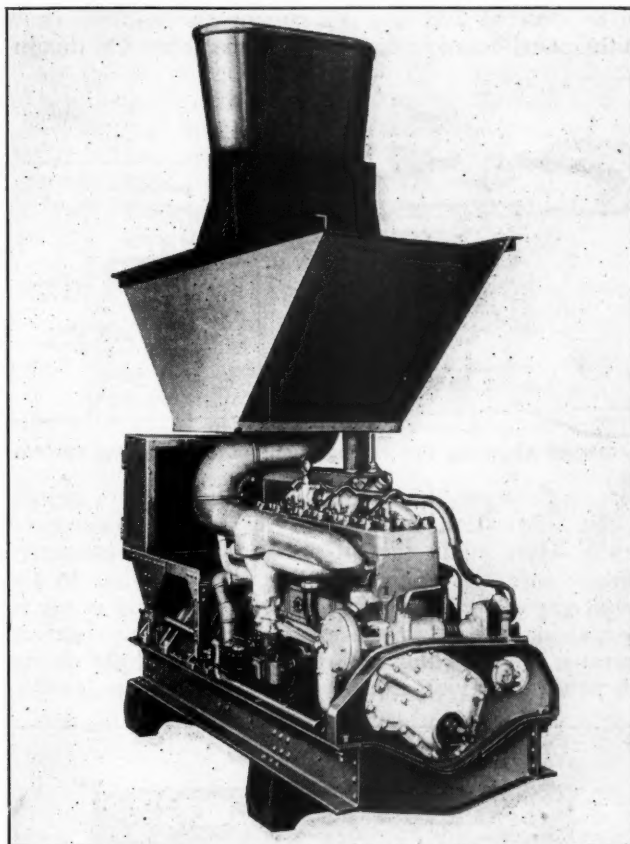
rapid transfer of heat to the jacket water. The inlet valves are of chrome-nickel steel, 2 1/16 in. in diameter and the exhaust valves of chrome silicon-steel, 1 15/16 in. in diameter. The 3 1/4 in. diameter crankshaft constitutes 300 lb. of the total engine weight of 1,800 lb.

The electrically controlled 2-in. standard carburetor draws fuel from a 110 gal. tank located underneath the car. A pressure of 5 lb. is constantly maintained on the fuel supply. Each unit has its own fuel tank which can be cut out in an emergency. Each tank is provided with a protector seal which will open in case of excessive pressure. An automatic magneto spark advance operates in conjunction with the carburetor.

The cooling system

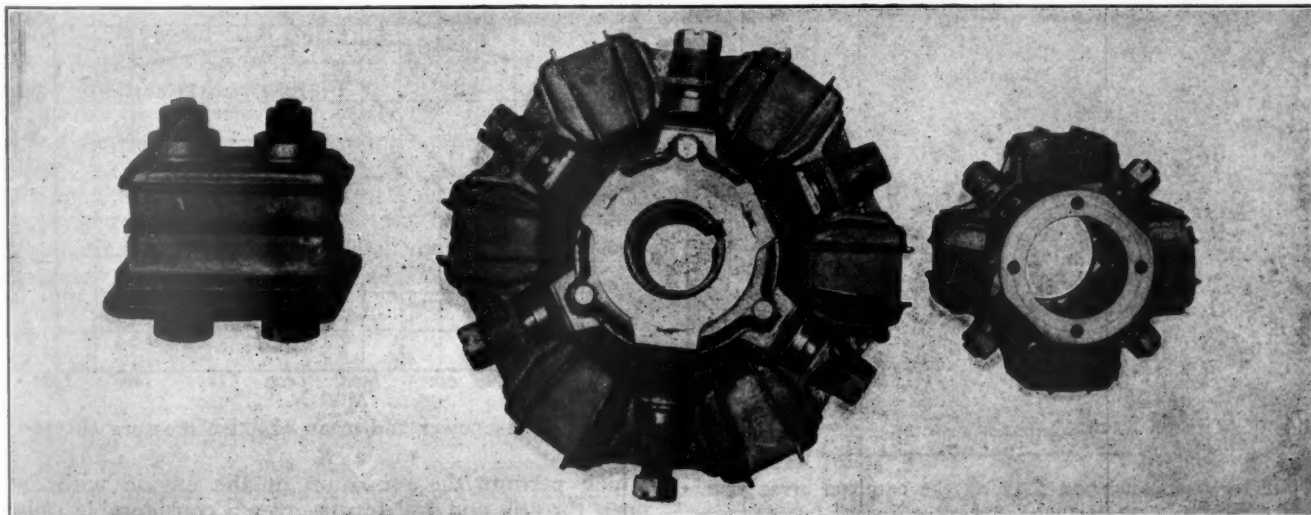
The cooling system is a combination of cellular radiators inside the car, an air eductor and roof radiators. The drain tank, indicated in the drawing showing the cooling system, holds 20 gal. of water, and is a part of the power plant unit. The water pump forces the water through the engine jacket, up through the roof radiators and then through the radiators in the air eductor stack from which it drains back into the tank. The air eductor stack consists of two sets of venturi-shaped stacks, located between the two radiators, all enclosed in a sheet aluminum housing. The partitions are filled with sound-deadening material. The engine exhaust, which is delivered through two outlets just below the two sets of draft pipes, in passing through the pipes produces an ejector action similar to the action of the exhaust in a steam locomotive when it enters the stack. A gas chamber shown at *F* on one of the photographs is attached to the exhaust manifold to smooth out the exhaust pulsations, and this has materially assisted the insulated eductor walls in muffling the sound of the exhaust, without building up back pressure. The air enters the eductor stack through the hood-shaped opening at the front of the car, passes down through the two cellular radiators and up out of the stack through the draft pipes. One eductor stack is provided for each unit and has a capacity of 6,500 cu. ft. of air a minute.

drawing. This allows the use of only the radiators in the eductor stack. Another protection against freezing is that when the engine is idling, owing to the lack of



The unit with the eductor in position

water pressure from the pump, the water drains from the roof and eductor stack radiator into the drain tank. If the water passes out of the jacket below a temperature of 160 deg., it is by-passed back into the jacket and



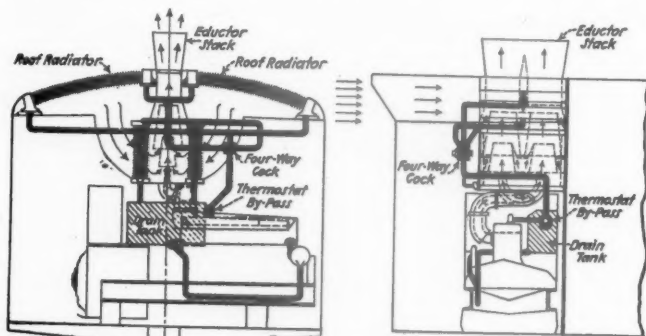
Left: One of the four rubber blocks on which the unit is supported—Right: The rubber torque insulators used between the engine and generator and in the air compressor drive

The cooling system maintains a water temperature of 160 deg. F. all the year. No anti-freeze solution is ever used in the water. In the winter, the roof radiators are cut out by the four-way cock shown in the

not pumped into the radiators. This is made possible by the thermostat by-pass control located just outside of the drain tank.

Another interesting feature is the location of the

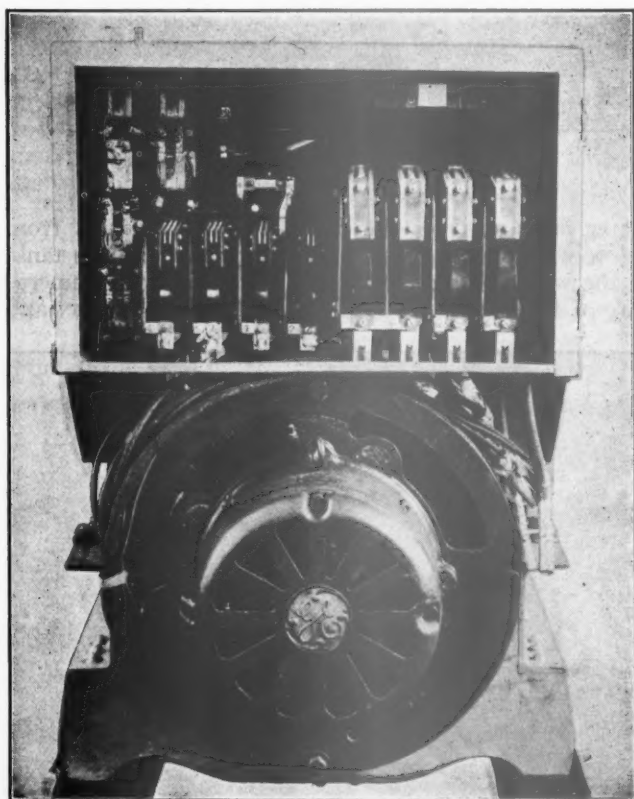
motometer. It is located directly on top of the cylinder head, thus eliminating a long pipe and connection to the operating cab. This gage has two electric wires which lead to a red light in the cab. The contacts are set to close at 200 deg. F. causing the light to show on the panel board in front of the operator. On this in-



Drawing showing the arrangement of the cooling system

dication he immediately cuts out the engine by a switch.

The lubrication is supplied by a two-pressure oil pump. Here again the oil pressure gage is connected directly into the engine oil line. In addition to the visual gage, a safety gage is provided. This is set so that, should the oil pressure drop to $\frac{1}{2}$ lb., an electrical circuit is closed which also produces a red light on the cab panel, notifying the operator that there is trouble.

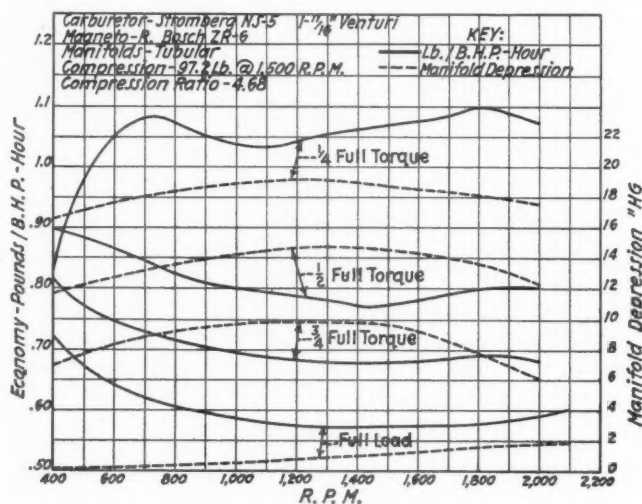


Front view of panel box showing the compact arrangement of the apparatus

The same lamp is lighted by the water temperature and the oil pressure circuits.

Each unit is equipped with a 12-cu. ft. capacity air compressor, which is gear driven and operates while the engine is idling, thus insuring air pressure at all times. Two fly wheel and a rubber torque insulator, which will take up a 10-deg. rotation, are mounted on

the drive shaft to eliminate the torque vibrations from the compressor, and the large fly wheel smooths out the vibrations from the compressor. The rubber torque insulator further smooths out the torque before it passes to the second fly wheel. This rubber torque insulator and the large type used on the generator drive shaft for the same purpose are both shown in one of the il-

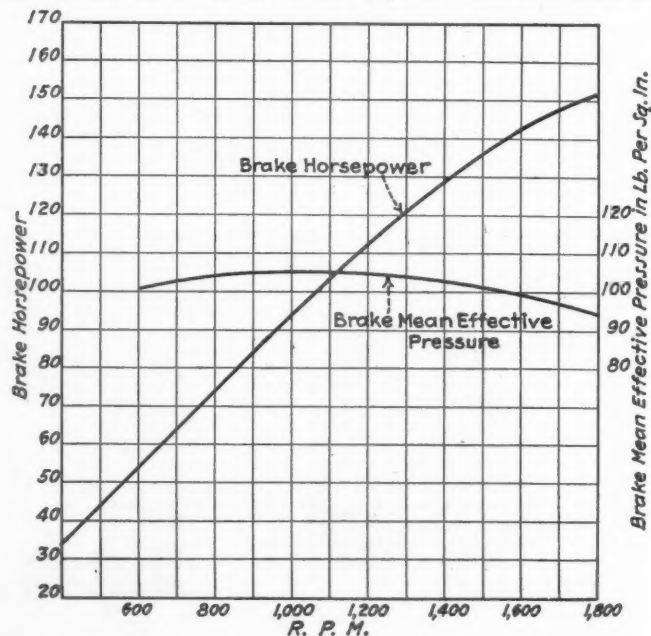


Fuel performance curves for various drive shaft torques

ustrations. The larger insulator takes up a maximum rotation of 15 deg.

The control

Probably the most unique feature of this power plant, considered as a whole, is the type of electrical control

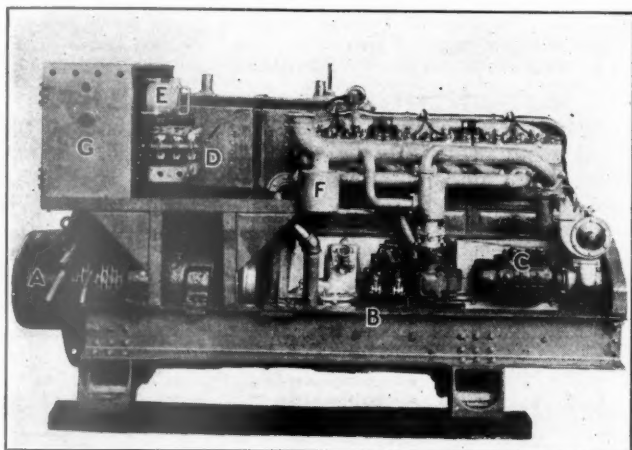


Brake horsepower and mean effective pressure curves

which permits the operation of the engine with full open throttle and full torque over a considerable range of speed and power output. The fuel economy curves of the Mack AP engine at various torques and speeds, shown on one of the charts, indicate a much lower fuel consumption per brake horsepower-hour when the engine is operated at full torque over the entire practicable range of speed regulation. Thus, at 1,350 r.p.m., which is the normal operating speed of the engine, the full load fuel consumption is .57 lb. per brake horsepower-

hour while at three-quarters full load obtained by throttling increases the unit fuel consumption to .68 lb. per horsepower-hour. On the other hand, should three-quarters of the full load horsepower be developed with a load which would reduce the speed of the engine to approximately 1,000 r.p.m. with a full throttle and full torque, the fuel consumption would be increased only about .58 lb. per brake horsepower-hour.

To take advantage of full torque fuel economy as far as possible, the control has been designed so that



Side elevation of the gas-electric unit with important parts enumerated—A: Exciter unit—B: Throttle control solenoids—C: 32-Volt lighting generator—D: Field regulating resistance—E: Receptacle to receive cable from controller—F: Exhaust gas chamber—G: Panel box for housing switches and contactors

when less than full power output is required the operator, by reducing the resistance in the generator field circuit, can cause the generator to overload the engine, slowing it down to a new balancing speed at which the reduced power required will be delivered with a full throttle. Regulation in this manner is possible down to two-thirds of full power. Below this, throttle regulation is necessary.

With the power plant operating at a given speed and corresponding full throttle power output, the inherent regulation of the generator, as the current requirements of the motors vary with changes in the speed of the car, causes the generator load to vary somewhat from the normal output and to unload the engine. By means of suitably arranged electrical contacts on the governor, the tendency of the engine to throttle itself under these conditions is followed immediately by a change in the generator field resistance which offsets the inherent tendency of the generator to vary from the full throttle power output of the engine at the speed under consideration.

Electrical equipment

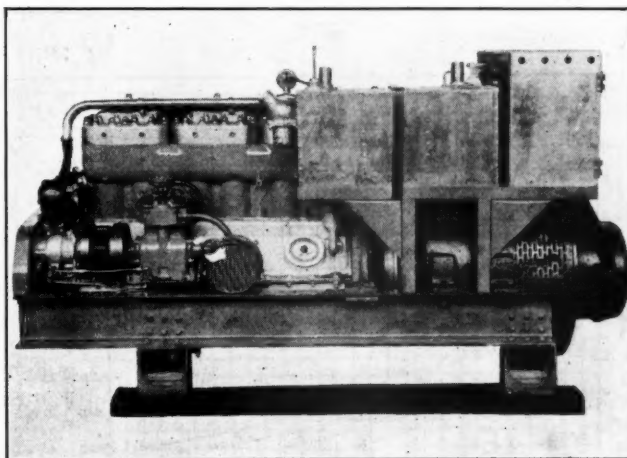
The power plant is designed to use either General Electric or Westinghouse electrical equipment. With the Westinghouse equipment the generator regulation to effect constant power output for varying current requirements is a motor-driven face plate rheostat controlled by the engine governor. With General Electric equipment this regulation is effected by a unique method of automatic control of excitation from the separate exciter to the main generator field which gives full engine loading at all car speeds.

The main generator, with a rating of 95 kw., operates

at a speed of 1,000 r.p.m., when reduced power is desired to 1,500 r.p.m. for full power. Compactness of design is apparent from the manner in which the various magnetic circuit controlling devices are mounted in the panel box directly over the main generator. The proximity of this panel to the generator makes it possible to use extremely short leads between the switches on the panel and the generator. The location of the generator itself with respect to the car motors is also such that the circuits between the generator and the motors are extremely short; in fact no heavy current carrying conductors are required other than the regular leads which accompany the generator and motors. The resistance units used to shunt the generator field circuit are conveniently attached to the rear of the panel, and immediately above these is located a receptacle into which is plugged the cable leading to the controller.

The lighting is accomplished by a 32-volt, 750-watt self-excited generator used in connection with a storage battery. Voltage regulation is accomplished by means of a differential compound winding doing away with all regulating devices. This generator is driven directly from the gear casing at the front end of the engine.

The entire control of the power plant by the operator is effected with a master controller of the remote control type to which current is supplied at 32 volts to operate the various magnetic switches, which in turn control the heavier current circuits. A number of unique features are built into the master controller which make for simplicity of operation. On the reverse handle provision is made for throwing on the maximum field of the generator, stalling the engine to a



The 12-cu.-ft. gear-driven air compressor and the 20-gal. drain tank

speed considerably under its normal operating speed. Also, in connection with the reverse lever, are contact points which control forward and reverse sanders.

The engine throttle is also operated by the master controller. With the controller handle in the off position, the ignition circuit is open and the engines are stopped. The first notch on the controller causes the generator to function as a starting motor, drawing current from the 32-volt battery. As soon as the engine starts, the battery is automatically cut out and the engine continues to idle. The next three notches operate first one and then the other, and finally both of two solenoids which provide two partial and a full throttle opening. The remaining control functions in the control panel are automatic and balanced.

The design and proportion of locomotive boilers*

A discussion of boiler ratios, firebox heating surface, superheaters and feedwater heaters

By C. A. Brandt

Chief engineer, The Superheater Company, New York

PART II

THE detrimental effect which too much air has on the efficiency of the boilers is perhaps not appreciated as much as it should be. The percentage of excess air admitted to the furnace is usually measured by gas analysis and represented by the percentage by volume of carbon dioxide in the flue gases. The theoretical amount of air required per lb. of combustibles for perfect combustion is 11.47, which is represented by a CO_2 percentage of 18.64. It is, of course, impractical to operate a furnace with only the theoretical amount of air admitted and it is usually conceded that an operation that results in about 15 per cent CO_2 by volume in the flue gases (which is equivalent to about 23.4 per cent excess air, or 14.17 lb. of air per pound of combustibles) represents good furnace operation. Numerous different locomotive tests, however, have been analyzed, showing a CO_2 percentage of nine, and lower, which represents 103.8 per cent excess air. The loss in boiler efficiency, is due to the fact that the excess air must be heated up from the outside temperature to that of the smokebox.

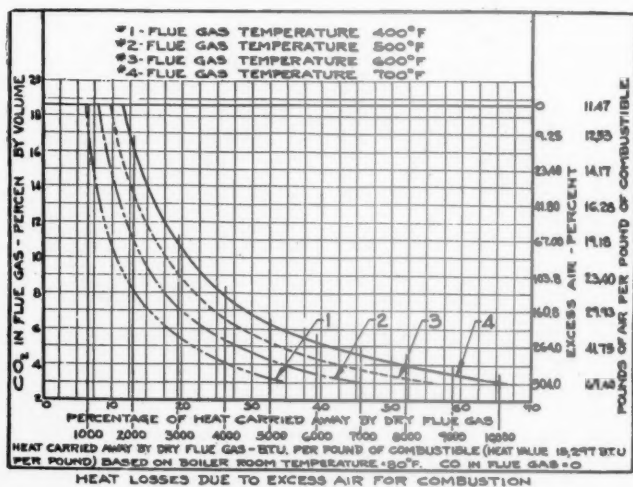


Fig. 6—How variations in the per cent of CO_2 in flue gases effect the heat losses

How serious this loss is may be realized when you consider that when burning 10,000 lb. of coal per hour with a smokebox temperature of 600 deg. and 9 per cent CO_2 , 23.4 lb. of air are used per pound of combustible as compared with 14.17 lb. with 15 per cent CO_2 . Thus, you will notice that, with the former operation you will heat up about 90,000 lb. per hr. of air unnecessarily from the temperatures of the outside air, which may be 40 deg. F. to that of the temperatures of the escaping smokebox gases, or a heat waste

represented by heating 90,000 lb. of air per hour to 540 deg. and throwing it out of the stack. This condition is no uncommon case. In order to make this condition more clear, some curves shown in Fig. 6, give the heat losses caused by excess air for various flue gas temperatures from 400 to 700 deg. F. You will note, for instance, if the smokebox temperature is 600

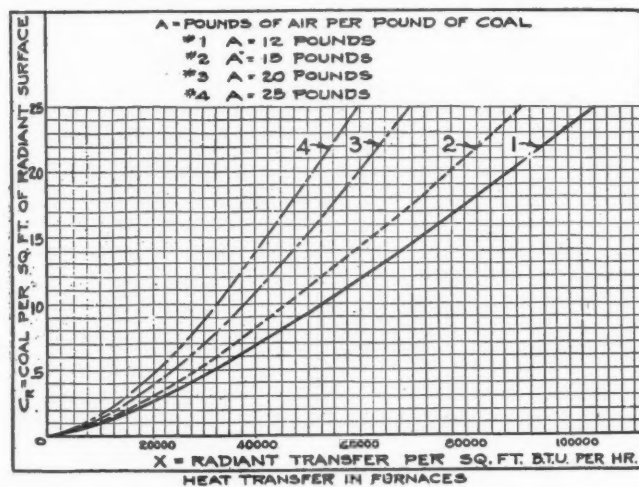


Fig. 7

deg. F., 7 per cent more heat is carried away by the dry flue gases per pound of combustible if the boiler is operated with a 9 per cent CO_2 as compared with 15 per cent CO_2 .

Combustion volume and firebox heating surface

We now come to another important item; namely, the combustion volume. Items No. 36 to 39 in Fig. 2 show various ratios of firebox volumes and it is noted that this ratio has jumped up about 100 per cent to 200 per cent, or from about four cubic feet per 1,000 tractive force to between 8 and 12 cu. ft. The benefit that this improvement has had upon the efficiency of combustion has been referred to before. I will here suggest that this ratio should be handled with care as it should bear a proper relation to the grate area as shown in column 38, Fig. 2. A ratio between 5.25 to 6.50 cu. ft. appears to give excellent results. It is questionable if it is economical to go to as high a ratio as 8 cu. ft. per sq. ft. of grate, except for very long locomotives where the tube lengths would exceed 22 ft. This indicates that the grate area should be increased.

The amount of firebox heating surface per square foot of grate area on modern locomotives is shown in item No. 40, Fig. 2, and the amount of evaporating heating surface per square foot of firebox heating surface is shown under item No 49.

* Abstract of a paper presented before the Canadian Railway Club, Montreal, Que., February 14, 1928.

The ratio of the firebox heating surface follows that of the combustion volume very closely and we may consider them together. The rate of heat transfer to the firebox sheet is very high. Mr. Cole in his locomotive ratios used the heat transfer rate equivalent to an evaporation of 55 lb. of water per hour per square foot of firebox heating surface. This has been a fair average for boilers of comparatively small ratios of firebox heating surface to grate area. When this is increased to a ratio of six or more, it is doubtful if this rate of heat

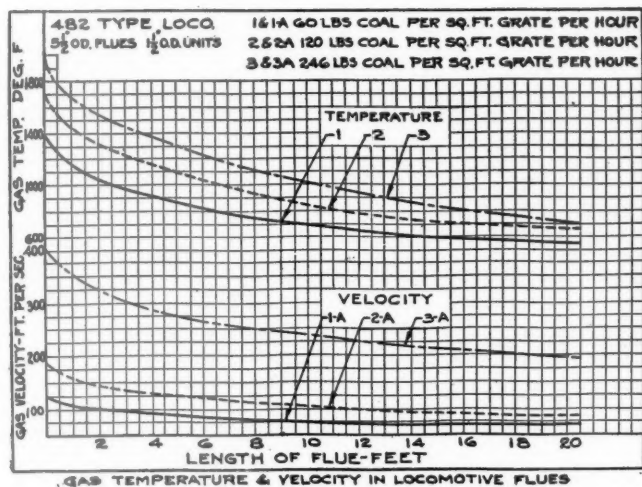


Fig. 8

transfer will be as high. Since Mr. Cole's ratios, based on Prof. Goss' experiments, were stated a great deal of additional data has been obtained. The recent papers presented by Prof. Christie, Mr. Fry, Prof. Wohlenberg, Mr. Orrok and Mr. Broido, on the subject of heat transfer by radiant heat in furnaces are very interesting and illustrating the complexity of the problem. The rate of radiant heat absorption depends on the condition of the surfaces, the relation and distance of the absorbing surfaces from the source of radiant heat, the

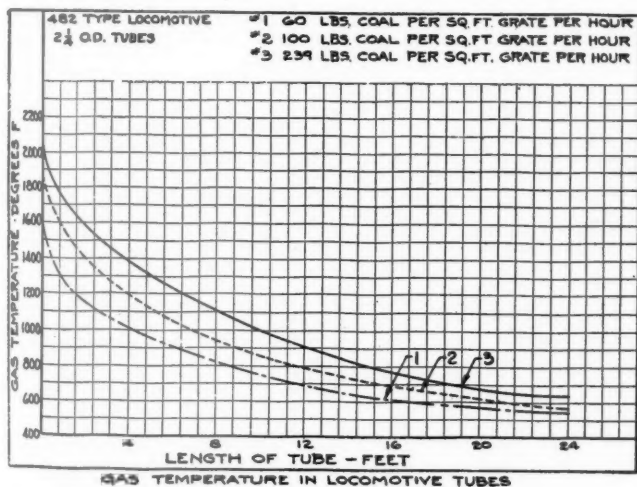


Fig. 9

temperature of the fuel bed and gas volume, condition and luminosity of the gases, the rate at which the fuel is burned, and the amount of heating surfaces.

In Fig. 7, a set of curves is given showing the radiant heat transfer in b. t. u. per square foot per hour, plotted against the quantity of coal burned per square foot of radiant surface for different conditions of firing as expressed in pounds of air used per pound of coal. These

curves were calculated by Mr. Orrok and published in Mechanical Engineering March, 1926. They are based upon all available data and tests. It will be noted that the rate of radiant heat transfer increases quite rapidly as the rate of firing increases. The rate of heat transfer in the firebox is of extreme importance to the designer of superheaters, as it is evident that the more heat that is absorbed in the firebox the less heat will be available for superheating.

The decision as to the minimum of heating surface that should be placed in the firebox should be determined on a common sense basis, and with all factors considered. We know from long experience that the heating surface in the firebox is the most expensive part of the locomotive to build and maintain. These surfaces are exposed to a temperature of 2,600 deg. F. or more. The amount of work done, or the rate of heat transfer is five times as great as that of the flue heating surface and the plates are exposed to sudden contractions and expansions. It would, therefore, appear that no more firebox heating surface should be used than necessary to give the proper firebox volume for the most efficient combustion at maximum rate. Any addition to the firebox heating surface above this is un-

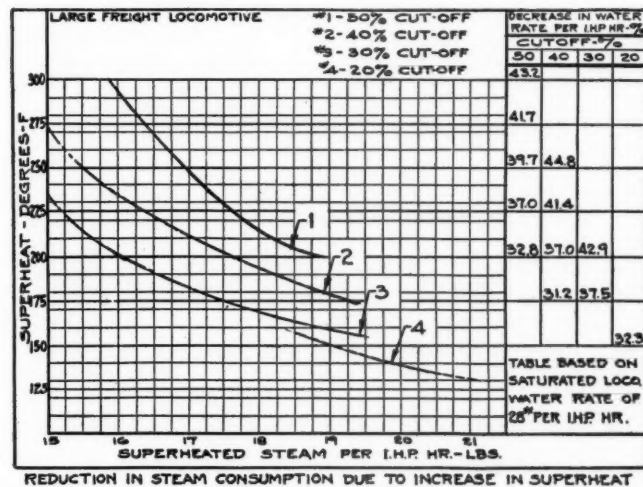


Fig. 10

economical not only because this heating surface is expensive, but because it will make it more difficult to obtain that most important thing; namely the high superheating of the steam.

The introduction of an excess of firebox heating surface which will tend to increase the firebox volume may not be detrimental to the furnace efficiency. When, however, excess firebox heating surface is introduced, and is so arranged as to reduce the temperature of the furnace below that necessary to produce efficient combustion and prevent the proper mixing of oxygen and carbon, it may be decidedly detrimental to the attainment of the best boiler efficiency and capacity and would be uneconomical.

Gas area through the boiler

Reference has been made to the importance of maintaining the maximum possible gas area through the boiler barrel. The draft loss through the tubes and flues is usually quite high, particularly when the gas velocity is increased with the rate of firing. An example of the high rate of gas velocity through the flues is shown in Fig. 8. You will note that, when a normal boiler is forced to a high rate the gas velocity through the flues at the flue sheet will be as high as 400 ft. per

second, or 24,000 ft. per minute. These gas velocities are calculated from the specific volume of the gases at corresponding temperatures shown in the temperature curves on the same figure. These gas velocity curves will illustrate very vividly why some locomotives must operate at such extremely high back pressures in order to pull the gases through the flues, indicating the importance of this question.

The total net gas area through the boiler is one of the most important factors that must be taken into consideration when designing a boiler. Items 41 to 45, Fig.

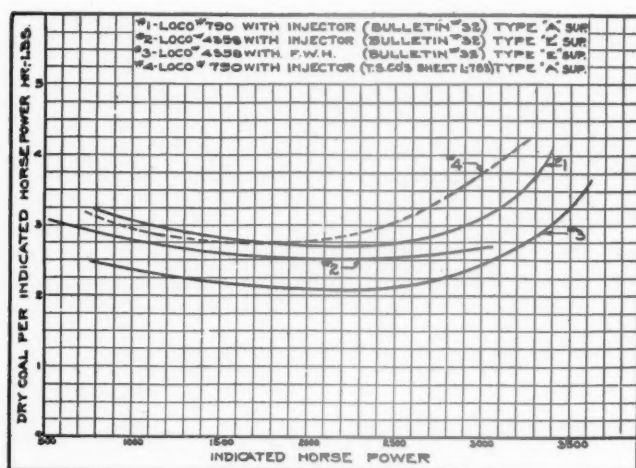


Fig. 11

2, show the various gas area ratios, and experience has shown that locomotives with a large total gas area through the boiler are capable of high capacity coupled with high boiler efficiency and low cylinder back pressure. The importance of the operation of the furnace with a minimum amount of air per pound of fuel is also emphasized when draft loss and gas area are considered.

In discussing the question of gas area, it is pertinent to mention some practical questions that enter into the detail design of the boiler. The maximum total gas area that can be put into a boiler of a given diameter is influenced by the available flue sheet area, minimum clearances between the flue holes, and the flange of the flue sheets, the tube spacing and the relation between the diameter of the boiler at the back end to that of the front end and, for combustion chamber locomotives, the water space between the combustion chamber and the barrel.

A great many locomotives have been built in the past where these dimensions and relations have not been properly considered, resulting in a very much smaller gas area and heating surface through the boiler than could have been installed.

On the question of flue spacing, it might be said that a $\frac{3}{4}$ -in. spacing has been quite universally used on recent locomotives throughout the country. Five-eighths inches and $\frac{11}{16}$ -in. have also been used to a great extent. There appears to be no logical reason for increasing the flue spacing above $\frac{3}{4}$ -in., as no well managed railroad today would permit the running of locomotives with excessive scale formation on the tubes. The severe reduction in heat absorption and efficiency, because of scale accumulation, is too well known to be discussed here.

With reference to the water spaces between the combustion chamber and the barrel, it would appear that a distance of 5-in. is quite universally and successfully

used. There has been considerable discussion on this subject, some arguing that a large water space should be provided and particularly at the bottom for the accumulation of mud. Experience has not proved that this is correct. In the first place, mud should not be permitted to accumulate around the outside of the combustion chamber. On the other hand, there have been cases where more trouble has been experienced with combustion chambers with greater water space than was experienced where this dimension was considerably less.

Mention was made that the relation of boiler diameter, front and back, is of great importance. It certainly will not be a good design to put in a large diameter third course and then pinch down the diameter of the front end to such an extent that the tube sheet area in the front end becomes the limit of the total number of tubes and flues that can be installed. As the limit on weights is usually determined by the weight at the back end, the back flue sheet area should be the controlling factor and the diameter of the front end should, in every case, be made large enough to take the maximum number of flues that can be installed at the back end. This has not always been the case and a study of this subject has shown that the diameter of the first course has varied as much as ten inches from the diameter of the third course for the same type of boiler.

Length of flues for proper efficiency

The question of maximum length of flues has been the subject of considerable discussion. One large railroad system has set 19 ft. as the maximum length of $2\frac{1}{4}$ -in. outside diameter flues that should be used with any boiler. The balance in the required length of the boiler has usually been made up by lengthening the furnace and combustion chamber. It appears, however,

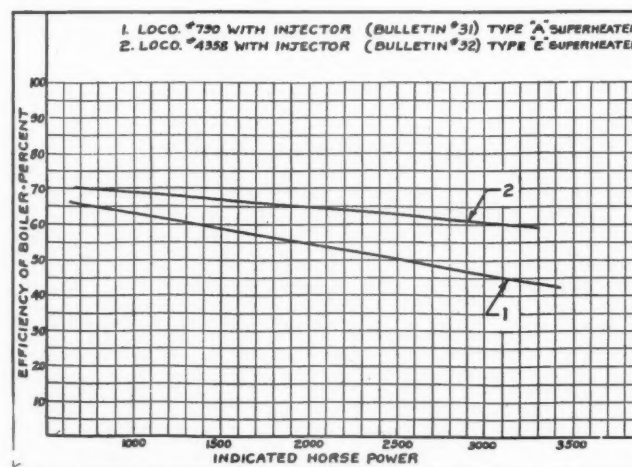


Fig. 12

from the records of recently built locomotives that about 21 ft. has been a popular length, with 22 ft. as a maximum. In older designs of locomotives, particularly of the articulated type, 24-ft. and 25-ft. tubes were used quite extensively, but these lengths have apparently been discarded in new designs. This is quite right, as numerous tests have shown that there is practically no reduction in the flue gas temperatures with flues of the commonly used diameters of more than 22-ft. in length. Additional length would appear to be useless heating surface, also imposing an additional draft loss that would not be warranted from the results.

The curves in Fig. 9, illustrate this condition. These temperatures were taken according to the most approved methods and can be considered accurate.

Evaporating rates for tubes and flues

This question has been left to the last, not because it is of small importance, but because a simple and easily

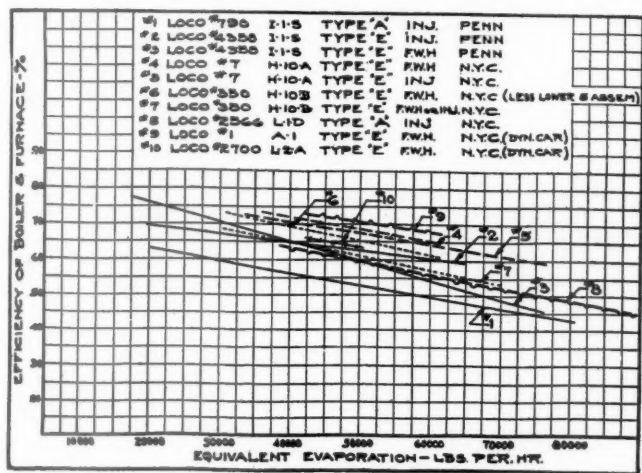


Fig. 13

applicable set of values has not yet been worked out that would satisfy the changed conditions of boiler proportions. It is to be hoped that adequate test data will soon be available for the accurate determination of such values. In the meantime the evaporation must be worked out for each individual locomotive in accordance with the well-known heat balance method.

The superheater

The importance of high sustained superheat has been proved so many times by numerous tests throughout the world that it is accepted among engineers as is the

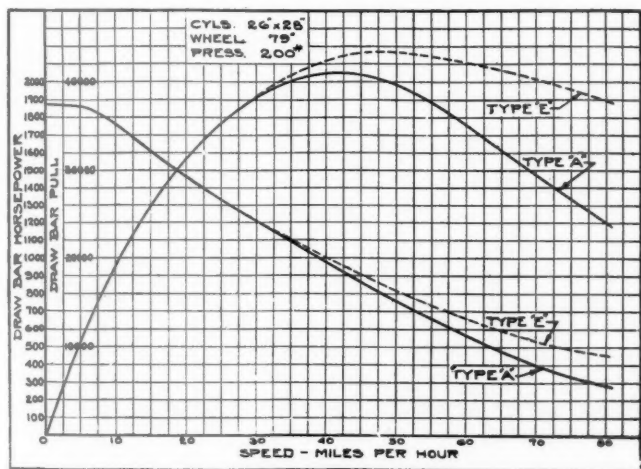


Fig. 14

law of gravitation. The fact, however, that cylinder efficiency increases as the temperature of the steam increases, even beyond those that have been common practice, is not quite as well understood. The effect of increased superheat or steam consumption is shown clearly by the various curves in Fig. 10.

These curves were taken from tests and illustrate the fact that superheat follows the law of increasing return. The production of high superheat on the modern locomotive, however, has been made more and more

difficult, due to radical changes in the boiler proportions of very large power. It has become necessary for the superheater designer to meet this condition by enlarging the capacity of the superheater. This has been done by increasing the superheating surface. The necessity of this is evident from the fact that less heat is left in the gases entering the flues, due to the greater heat absorption in the large fireboxes, which decreases the heat available for superheating. The use of feed-water heaters and exhaust steam injectors also, by reclaiming heat that would otherwise be lost, reduces the rate of firing that is required for the same evaporation and naturally decreases the amount of heat offered to the superheater flues.

On the extremely large locomotives of today, the steam space in the boiler has been substantially decreased. The steam liberating surface, has also decreased in proportion to the total amount of water delivered by the boiler. Both of these conditions have contributed to a marked increase in the amount of water that is carried by the steam from the boiler to the superheater. As the evaporation of one per cent of mois-

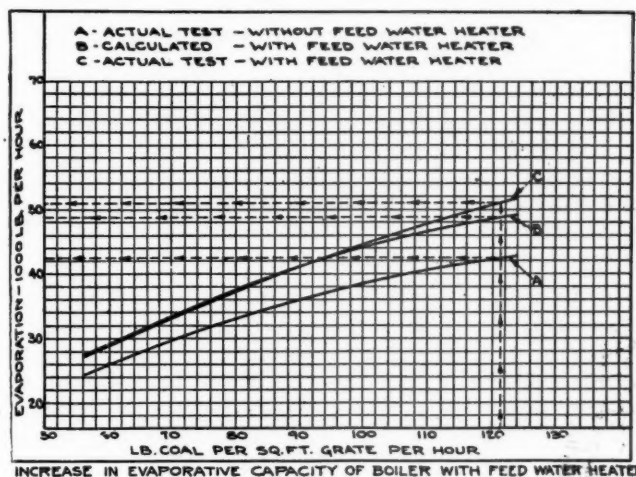


Fig. 15

ture requires as much heat as a superheat of 17 deg., it is a difficult task to provide an adequate superheater as steam may carry five per cent, or more, of moisture when it enters the superheater units. This condition not only points to the necessity for a greater capacity superheater, but to the importance of proper handling of the water level on the road.

The increased demand for operating trains at higher speeds, requiring more steam for a given size of locomotive, requires superheaters of greater capacity, in order that these demands on the boiler may be met without a too serious sacrifice of boiler efficiency and evaporating capacity. The greatest possible total steam area through the superheater is also very important as it will result in less pressure drop through the superheater units. The result of this condition led to the development of a somewhat different arrangement of the superheater unit in a design usually referred to as the Type E.

Results obtained with the superheater

The characteristics of the Type E superheater have given satisfactory results in service tests. Fig. 6 shows the results of tests conducted during 1923 and 1924 on the I-1s class, 2-10-0 type engine of the Pennsylvania. Curve 1 on Fig. 6 shows the performance of one of these locomotives having a Type A superheater, while Curve 2 shows the performance of one on an identical

water heater. Curves *A* and *C* were taken from an actual test, and *B* was calculated in accordance with the foregoing method. The evaporation shown on curves *B* and *C* are the net after deducting the steam consumption of the feed pump. Curve *A* without a feed water heater, shows an evaporation of 42,500 lb. per hour at a coal rate of 120 lb. of coal per sq. ft. of grate per hour, while *B* with a feed water heater, shows a calculated evaporation of 48,800 lb. at the same coal rate. Curve *C* shows the actual results from test with a feed water heater at the same coal rate, and shows an evaporation of 51,250 lb. per hour, which is a net increase of 20.6 per cent in evaporation without burning any additional fuel. The actual results obtained on test are slightly better than the theoretical.

Fig. 16 shows the proportions, according to Cole's ratio of two boilers, one designed with a feed water heater and the other designed for the same capacity without a feed water heater. Both have a maximum evaporation of about 50,000 lb. per hour with a coal rate of 120 lb. per sq. ft., of grate. In proportioning the non-feed water heater boiler *B* it is of course necessary to increase the heating surface, grate area and the firebox to maintain the same rate of fuel burned per sq. ft. of grate per hour as in the feed water heater boiler. It is noted that the non-feed water heater boiler *B* must be made $5\frac{1}{2}$ in. larger in diameter and that boiler *B* without a feed water heater, will weigh net 15,000 lb. more than the boiler with a feed water heater.

Effect of the feed water heater on boiler efficiency

While the same evaporation is being obtained with boilers *A* and *B*, they are burning 120 lb. of coal per sq. ft. of grate. In order not to lower the efficiency of boiler *B* it was necessary, as previously stated, to provide a larger grate than for boiler *A*. At this coal rate, the feed water heater boiler with 52 sq. ft. of grate will burn 6,318 lb. of coal per hr. and the non-feed water heater boiler with 61.8 sq. ft. of grate, will burn 7,500

lb. of coal per hr. Boiler *A* is, therefore, using 15.9 per cent less coal than boiler *B*. This shows that, in addition to saving 15,000 lb. in the weight of the boiler and water, the feed water heater is effecting a fuel saving of 15.9 per cent. Fig. 17 shows a comparison between the boiler efficiency with and without a feed water heater.

Effect of a feed water heater on back pressure

Curve *A* in Fig. 18 shows the actual evaporation

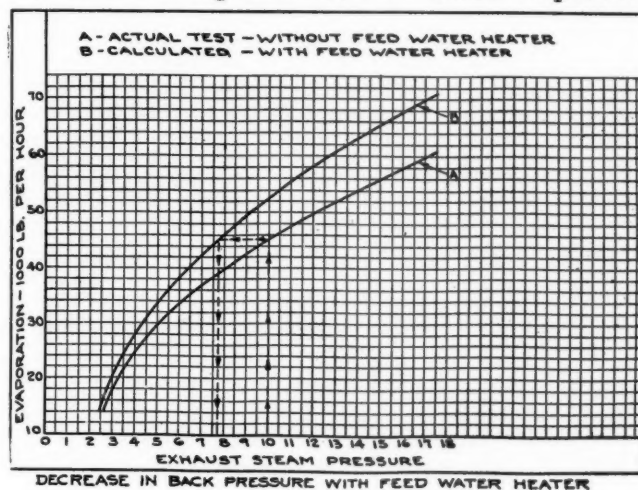


Fig. 18

plotted against exhaust pressures for locomotive recently tested. Curve *B* shows the evaporation with a feed water heater. It will be noticed that at 15 lb. exhaust pressure the evaporation with a feed water heater is increased from 56,000 to 65,562 lb. per hour or a net increase of 17.1 per cent, and that an evaporation of 45,000 lb. per hr. will be obtained with $7\frac{3}{4}$ lb. exhaust pressure when a feed water heater is used as compared with 10 lb. pressure required for a non-feed water heater.

Calculating the stopping distances of trains

An explanation of the various steps and the mechanics involved in using hand book formulas

By G. E. Terwilliger

Supervisor of auxiliary equipment, New York, New Haven & Hartford, New Haven, Conn.

FEW air brake supervisors and foremen are high school graduates and fewer still ever went to college. In the majority of cases they have arrived at their present positions through many years of very practical training either as a locomotive engineman, or in the air brake repair room in the shop. Usually, they have started railroading in their early youth. So far, I have been unable to find a hand book of which the author has appeared to be cognizant of this situation. Quite often they skip seemingly unimportant steps in the derivation of formulas with a nonchalance that is surprising. Undoubtedly, it may seem simple to the

author, but it is all Greek to many men who are expected to use the information.

This presents a situation, however, that is serious in many respects. It is a customary thing for the air brake supervisor to be called into court as a witness to give expert testimony. Testifying for the railroad in rear end collisions or highway crossing accident cases means that he must know his stuff. The average lawyer is never satisfied with the mere statement of a formula; he usually asks questions relative to the derivation, if for no other object than to embarrass or confuse the witness.

Take for example the formula commonly used in

computing the stopping distance of moving trains. This formula, which is

$$\frac{V_1^2}{30 P e f} + V_1 T$$

is found in practically all hand books on air brakes. Still, the writer will challenge anyone to find in any of the handbooks an explanation of the constant 30. It is indeed a delight to study the derivation of such a formula as this and note how the author blithely tells us to use this constant, but neglects to tell what it is and where it came from.

In making studies of stopping distances of moving bodies, an understanding of certain fundamentals is necessary if the subject is to be of any material value to the reader. It is not our purpose in this discussion to dwell upon the mechanics of the subject in detail, but to show the derivation of some of the terms or values used in this formula, which is so important to air brake men.

Explanation of the train-stop formula

In the formula given in the preceding paragraph

V_1 = Velocity in miles per hour (before the brake application starts)

V_2 = Velocity in feet per second when the brake application starts

30 = A constant

P = Braking ratio

e = The efficiency of the brake rigging

f = Coefficient of friction

T = Time required to get the brakes applied in seconds

The miles per hour, V_1 is found by multiplying the number of feet per second by the number of seconds per minute and the number of minutes in one hour, (which gives the number of feet per hour) and dividing by 5,280, the number of feet per mile, which gives the speed in miles per hour. The speed in feet per second, for example, at one mile per hour, is found by dividing 3,600, the number of seconds per hour, into 5,280, the number of feet per mile; thus

$$\frac{5280}{3600} = 1.467.$$

If the speed in miles per hour is known, the speed in feet per second may be found by multiplying 1.467 by the speed in miles per hour; thus $1.467 \times 60 = 88$, or 88 ft. per sec., at 60 m.p.h. If the time consumed in seconds in running one mile is known, the speed in miles per hour can be determined by dividing the time consumed in running one mile (in seconds) into the number of seconds in one hour, thus

$$\frac{3600}{60} = 60 \text{ miles per hour, or}$$

$$\frac{3600}{120} = 30 \text{ miles per hour}$$

The value of the braking ratio P refers to the relation of the total braking force (brake shoe pressure) to the light weight of a car. For example, consider a car weighing 100,000 lb., with a total braking force of 90,000 lb., the braking ratio is

$$\frac{90,000}{100,000} \text{ or } 90 \text{ per cent.}$$

The recommended braking ratio for freight cars is 60 per cent of the light weight and for passenger cars it is 90 per cent of the light weight. These ratios are based on 50 and 60 lb. brake cylinder pressure, respectively.

Now consider the car above referred to as having a braking ratio of 90 per cent of the light weight and assume that there is a load of 20,000 lb. in it, making the total weight, $100,000 + 20,000 = 120,000$ lb. The braking ratio is now

$$\frac{90,000}{120,000} \text{ or } 75 \text{ per cent.}$$

Another important factor in this connection is the actual brake cylinder value. Assuming the 100,000-lb. car in question, braking at 90 per cent, based on 60 lb. brake cylinder pressure, the braking ratio per pound of

brake cylinder pressure is

$$\frac{90}{60} \text{ or } 1.5 \text{ per cent.}$$

Let us suppose that instead of the car being loaded and obtaining 60-lb. brake cylinder pressure, the car is empty and 90-lb. brake cylinder pressure is obtained, the braking ratio under these conditions would be 1.5×90 , or 135 per cent. On the other hand, if only 50-lb. brake cylinder pressure is obtained, our braking ratio would be 1.5×50 , or 75 per cent. These stand out prominently and appreciably vary the length of stop. Leaking of brake cylinder packing, lack of inspection and inadequate supervision and maintenance are the contributing factors that raise or lower the value P .

The value e refers to the efficiency of the foundation brake rigging or the relation between the actual and calculated brake shoe pressure; the former may be more or less than the latter. However, whether it is more or less will depend upon design and maintenance. It will be obvious that adequate supervision and proper maintenance play an important part in assuring that the value e does not vary materially. Considering again the car above referred to as weighing 100,000 lb. and braking at 90 per cent, if the brake rigging efficiency is 80 per cent, then the braking ratio would be $.80 \times .90$, or 72 per cent.

The value f refers to the coefficient of friction and may be defined as the measure of tangential force acting on a wheel in relation to the normal brake shoe pressure. This value varies with the speed, time and other conditions which tend to create what may be defined as a lubricant between the brake shoe and the wheel with which it is in contact. Figures taken from the report of the Westinghouse-Galton tests indicate, for example at 40 m.p.h., that the maximum and minimum coefficients of friction were .194 and .088, respectively and the average or mean was .14.

The product of ef is termed the efficiency factor and if raised or lowered singly or otherwise, the stopping distance will be varied correspondingly.

The constant 30, which none of the hand book writers seem to want to talk about, refers to necessary factors in the mechanics of the subject and is found by dividing the square of 1.467 into 2×32.2 . This equals 29.92 and for convenience is taken as 30.

$$KE = \frac{1}{2} MV^2 \text{ where}$$

$$KE = \text{Kinetic energy in foot pounds}$$

$$M = \text{Mass}$$

$$V = \text{Velocity in feet per second}$$

The mass M is equal to the weight, divided by the acceleration due to the action of gravity or

$$M = \frac{W}{g}, \text{ in which}$$

$$W = \text{weight or force}$$

$$g = 32.2 \text{ ft. per sec. per sec., the acceleration due to gravity}$$

Substituting this value of mass in the kinetic energy formula, we have

$$KE = \frac{WV^2}{2g}$$

It will be remembered that the value of V_1 , the velocity, expressed in miles per hour, is equal to 1.467 times V , the value of the velocity expressed in terms of feet per second. If we substitute this for V in the equation, it becomes

$$KE = \frac{W (1.467 V_1)^2}{2 \times 32.2}$$

It has already been pointed out that $2 \times 32.2 \div 1.467^2 = 30$. Hence

$$KE = \frac{W V_1^2}{30}$$

It is for the same reason that the constant 30 is used in that part of the formula for the stopping distance in which velocity is expressed in miles per hour.

The braking force is that which prevents or stops the motion of a car. When a car is in motion it possesses kinetic energy, or a certain capacity for doing work. It is expressed in foot-pounds and is equal to one-half of the product of the mass times the square of the velocity, as explained above. As an example, the number of foot-pounds of work contained in a car moving 30 m.p.h., (44 ft. per sec.) weighing 20,000 lb. would be $20,000 \times 30 \times 30 \div 30 = 600,000$ ft. lb.

When brake shoe pressure is applied to the wheels of a moving car the kinetic energy in the car works against the resistance of friction and must be overcome if the speed of a car or train of cars is to be retarded.

Tests which have been made indicate that when a full service brake application of 24 lb. brake pipe reduction is made pneumatically in approximately 15.5 sec. from an initial brake pipe pressure of 110 lb. with a nine-car passenger train, then the value T plays an important part in train stop computations. In other words this factor refers to the time required to obtain a full service brake application. The time to get the brakes applied, times the velocity in feet per second, V_2 , should be added to the value obtained from

$$\frac{V_1^2}{30 Pef}$$

although there may be some deceleration realized during the time the brakes are being applied. Making this addition will allow a margin for safety.

A practical application

We are now ready to apply the formula in the stopping of a nine-car train from an initial speed of 40 m.p.h.

$$\frac{V_1^2}{30 Pef} + V_2T$$

or, written another way

$$\frac{40 \times 40}{30 \times .90 \times .80 \times .140} + (58.6 \times 15.5) = \frac{1600}{30 \times .90 \times .80 \times .14} + 908 = 1,435.$$

If one or more of the factors P , e or f is increased the theoretical stopping distance will be varied

$$\frac{1600}{30 \times .90 \times .85 \times .194} + 908 = 1,267.$$

In the last computation .85 was used as the value for e and .194 for f , the maximum coefficient of friction recorded in the report of the Westinghouse-Galton tests, instead of .80 and .14 as in the former case.

From the above it will be noted that the stopping distance from a given speed will vary considerably, depending upon the factors involved in the computation.

In addition to the foregoing, perhaps there is nothing that affects the stopping distance to as great an extent as does the length of the train where pneumatic brakes are employed. It may be of interest to the reader to stress the fact that the longer the train the longer it requires to get the brakes fully applied. A continuous service brake pipe reduction of 20 lb. requires approximately one minute with a train of 75 cars.

As explained above, the braking ratio is materially affected by the load to light ratio of a car or cars. For example, take a train of 75 cars all having light weights of 30,000 lb. each and a load capacity of 60,000 lb. This means that the load to light ratio is

$$\frac{30,000 + 60,000}{30,000}$$

or 3 to 1, and if the braking ratio is 60 per cent of the

light weight the braking ratio of the cars in question is—

or $1/3$ of 60, or 20 per cent. The stopping distance for such a train is obviously much greater than that for a

passenger train where the braking ratio is not materially reduced by the load in the cars.

Stopping a 75-car train

Let us now apply the above formula to the stopping of a 75-car freight train, where

$$\begin{aligned} V_1 &= 40 \text{ m.p.h.} \\ P &= 20 \text{ per cent} \\ e &= 80 \text{ per cent} \\ f &= 19.4 \text{ per cent} \end{aligned}$$

$$\frac{40^2}{30 \times .20 \times .80 \times .194} + 58.6 \times 60 = \frac{1600}{30 \times .20 \times .80 \times .194} + 3516 = 5,226$$

The value P therefore is a factor which must be known before any determination can be reached as to what the stopping distance may be.

In addition to the foregoing it may be necessary to consider the effect of the gradient. When stops are made on a descending grade the formula is

$$\frac{V_1^2}{30 (Pef - G)} + V_2T$$

or if on an ascending grade.

$$\frac{V_1^2}{30 (Pef + G)} + V_2T$$

The value G refers to the per cent grade and is expressed as a decimal. If the gradient involved in a computation is $1/2$ of 1 per cent descending, the decimal .005 should be subtracted from the product of Pef . If on an ascending grade it should be added to the product of Pef .

Example—Find the stopping distance of a passenger train from an initial speed of 40 m.p.h. on a descending grade of $1/2$ of 1 per cent.

$$\frac{40^2}{30 (Pef - G)} + V_2T = \frac{1600}{30 (.90 \times .85 \times .19 - .005)} + V_2T = \frac{1600}{4.21} + 911 = 380 + 911 = 1,291 \text{ ft.}$$

If on an ascending grade we would have

$$\frac{1600}{4.51} + 911 = 305 + 911 = 1,215 \text{ ft.}$$

In the case of a freight train with the following values:

$$\frac{40^2}{30 (.20 \times .85 \times .19 - .005)} + 60 \times 58.8 = \frac{1,600}{.819} + 3,528 = 1,959 + 3,528 = 5,487 \text{ ft.}$$

If on an ascending grade we would have

$$\frac{1,600}{1.119} + 3,528 = 1,439 + 3,528 = 4,957 \text{ ft.}$$

What a difference in the stopping distance of a freight train of 75 loaded cars on a $1/2$ of 1 per cent grade descending and a passenger train of nine cars on a level track! But this is not all. The values for P used in the above calculations may be lower than those used; it may be as low as .15. This is simply to show that the fast moving freight train with a low braking ratio should be considered when spacing block signals or in the spacing of trains, especially if long, heavy trains are to be operated between passenger trains.

These computations do not take into consideration the delay time encountered in train control territory nor of the effect of the throttle being left open during the progress of the stop. Whatever the delay time may be in seconds it must be multiplied by the speed in feet per second and added to the above calculations.

* * *

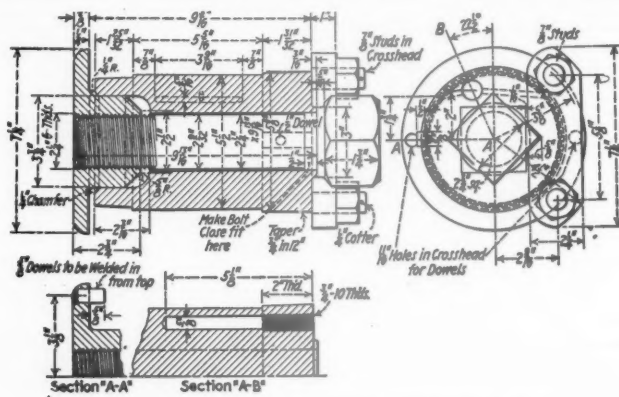
COMPRESSORS AND PUMPS.—The Ingersoll-Rand Company, 11 Broadway, New York, announces the publication of a new 44-page bulletin on ER and FR compressors and vacuum pumps. These are small and intermediate size machines. The compressors are of the straight-line type and are furnished for handling either air or gas. The vacuum pumps are single stage machines that differ from the compressors only in the vacuum cylinder. FR units are steam driven.

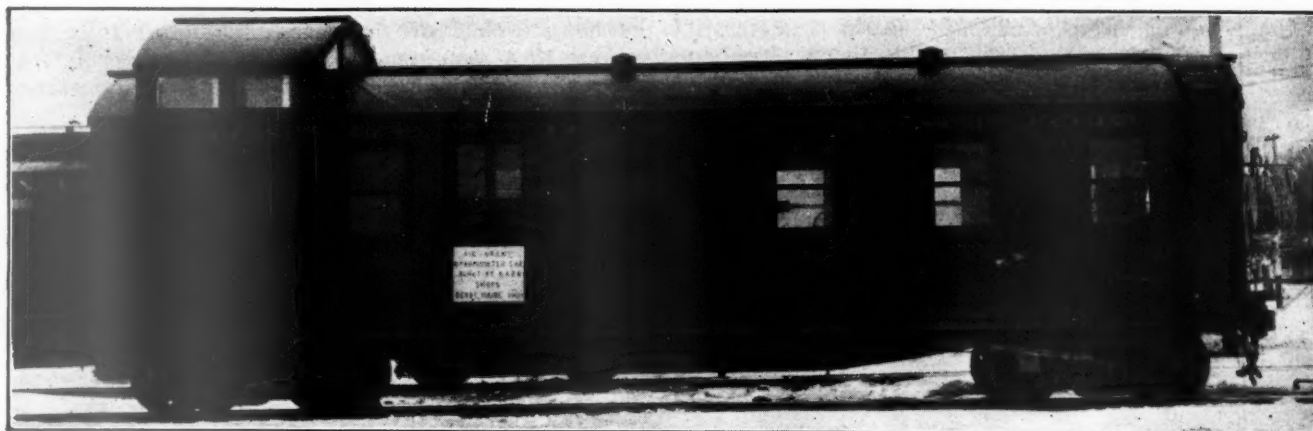
Application of crosshead pins on the St. L.-S. F.

THE crosshead pin application and the method of lubrication shown in the drawings was designed by A. H. Oelkers, chief mechanical engineer, St. Louis-San Francisco, to take the place of a flanged type of crosshead pin formerly used which was applied from the outside of the crosshead and secured by four studs. Considerable difficulty was experienced with the flanged

types by the retainer strap, as shown in the detail drawing of the crosshead pin. The retainer strap is secured to the crosshead pin by $2\frac{7}{8}$ -in. studs. This arrangement provides a more secure fastening than that of the flanged type.

The detail drawing of the crosshead pin also shows the method used on the St. Louis-San Francisco for ap-





The Bangor & Aroostook air brake and dynamometer car built at the Derby, Maine, shops

Bangor & Aroostook builds own dynamometer car

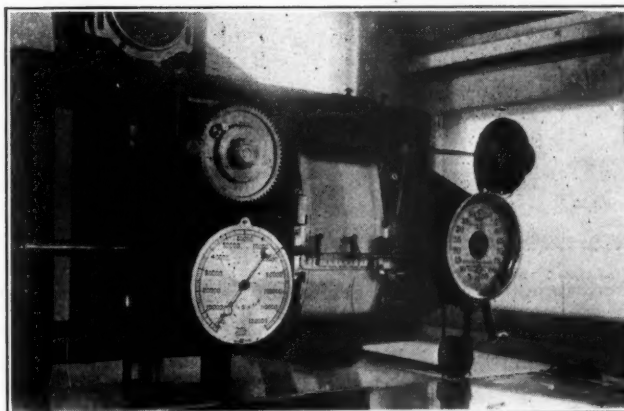
Cost of equipment, \$600—Much informative data has been secured by the use of this instrument

IN 1925, it was becoming necessary on the Bangor & Aroostook to use two locomotives to haul certain freight trains which had ordinarily required one locomotive for the same tonnage. It seemed evident that the full capacity of the locomotives was not being utilized, but the use of a dynamometer car was considered the only accurate means of determining the truth of this supposition. It was finally decided to design and build a dynamometer at the shops at Derby, Me. The dynamometer, which was first installed in a caboose, was used extensively during 1926 and much interesting and valuable data was collected. During 1927, it was decided to build a new air brake instruction car and one end of this car was used for the installation of the dynamometer equipment. The cost to build and install the dynamometer and recording apparatus was about \$600.

Rebuild old box car

The present air brake and dynamometer car was provided by completely rebuilding an old box car. A heavy fish-belly center sill was applied and the car was fitted with modern trucks and 6-in. by 8-in. couplers. The dynamometer equipment is located in the end of the car, on the roof of which the cupola has been built. The

weighing head is set in the drawbar yoke in place of a Miner draft gear. A dual hand brake was applied permitting its application from the inside of the car as



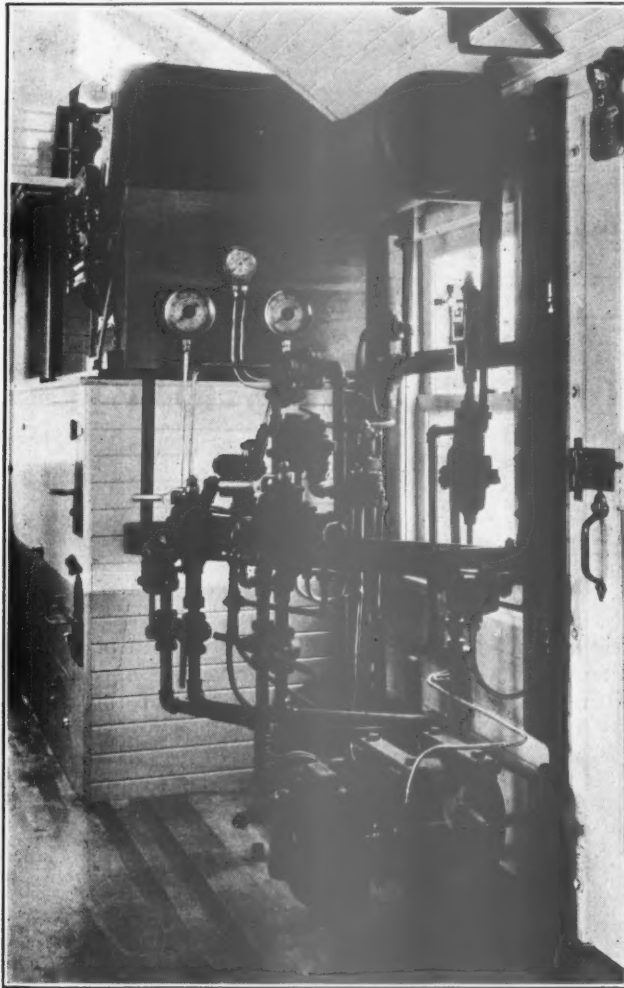
The dynamometer recording instruments

well as from the outside. The car is piped with a steam line for use in passenger service.



A view under the car showing the drives for the two speed recorders

The weighing head, which is 9 in. in diameter, is made from a locomotive axle. The piston chamber, which is 5 in. in diameter, and the piston which is $6\frac{1}{2}$ in. long, are both accurately ground to a close working



The locomotive air brake equipment, with the dynamometer recording station in the background

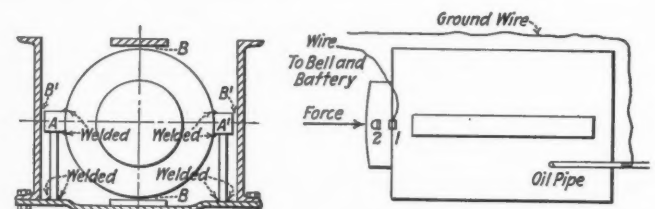
fit. The maximum piston travel is $\frac{1}{2}$ in. The piston exerts its pressure against oil which is prevented from leaking from the pocket by a leather cup gasket held in place on the end of the piston by three $\frac{5}{8}$ -in. studs. Two lugs are welded on the outside of the weighing head. These lugs rest on two upright strips welded to

the bottom plate of the center sill so as to reduce friction to a minimum. These are the only points at which the weighing head is supported. It has clearance at all other points.

A $\frac{3}{8}$ -in. pipe leads from the weighing head oil pocket to a cut-out cock and a safety valve located underneath the car, and then passes through the floor up to the table on which the recording instrument is placed. The purpose of the cut-out cock is obvious. The safety valve protects the drawbar recording gage against heavy shocks. When a sudden shock exceeds a predetermined pressure to which the valve is set, the valve opens and allows the oil to bleed out.

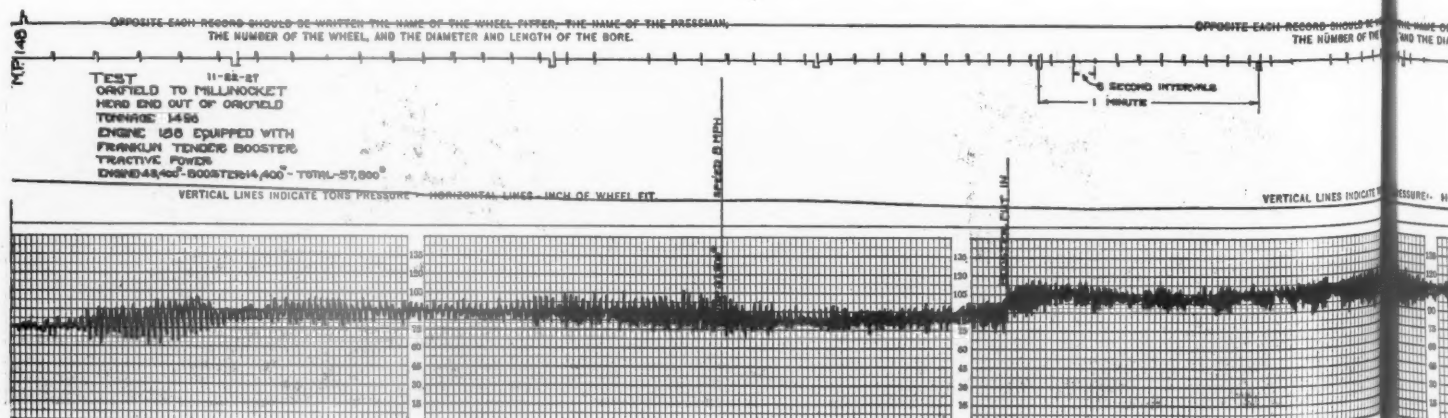
A pulsating valve is located in the oil pipe line just beneath the instrument recording table. The purpose of this valve is to prevent excessive pulsation of the drawbar recording pen. This valve is also used to cut out the weighing head when the car is not in dynamometer service.

A clever arrangement has been worked out to warn the operator when the quantity of oil in the dynamom-



Left: The weighing head is supported at the two points A and A', with $\frac{1}{8}$ in. clearance at BB—Right: Weighing head low oil indicator wiring; Contact (1) is insulated from the weighing head and ram

eter diminishes enough to allow the piston to travel beyond a predetermined point. One of two wires is connected to a contact point attached to the weighing head, but insulated from it, and the other to the brass oil pipe. These wires pass through the floor to the dry cell batteries and then to a bell located on the recording table. When oil seepage allows the ram to travel beyond a predetermined point, it will be seen in the sketch that a contact is made between the insulated connection (1) and the non-insulated contact point (2) on the ram, which closes the circuit, causing the bell to ring. The wire connections underneath the car can be seen in one of the illustrations. Two Alemite fittings have been installed in the oil pressure line; one underneath the car and one under the instrument board. These fittings are



A section of a dynamometer recording chart showing the text data, time intervals and when the booster was cut in

fastened together. This unit is located beneath the recording table. A rod leading from the magnets passes through the table to a bell crank which connects with the horizontal rod that moves the pen. This series of levers may be seen in the illustration to the left and just below the Boyer gage. Three wires lead from the magnets to the Seth Thomas clock located on the front wall of the cupola. One of these wires serves as a ground connection. Each of the other two wires connects one of the magnets with the clock mechanism.



A Baker valve gear model together with sectional models of equipment used on cars and locomotives

One circuit is closed at intervals of six seconds and the other at one minute intervals, the two magnets moving the pens in opposite directions from its base line.

The fourth pen records the mile posts. A telegraph key shown at the right of the illustration, is connected up with the magnet of an automobile horn, as shown directly above the Boyer gage. A connecting arm extends from the magnet to a perpendicular arm to the lower end of which is attached the mile post pen. As a mile post is passed, the operator touches the key which closes the magnet circuit and causes the magnet to actuate the pen.

The gear and pinion, shown in the illustration, is connected to the drive shaft of the Warner speed recorder and drives the paper at a rate proportional to the speed of the car. The tension on the paper is regulated by a carefully calibrated clock spring. A piece of a typewriter roll, shown in the illustration, bears on the paper directly over the driving roll to prevent slipping. The paper travel is 23 in. to the mile. Three rolls of paper are equivalent to 100 miles.

Directly in front of the recording instrument, under glass, is the road profile which is rolled by hand on two drums. This profile drawing covers the entire road.

An air gage is located on each side of the electric clock. One gage shows the auxiliary reservoir and brake cylinder pressures and the other gage shows brake pipe and auxiliary reservoir pressures. These gages are used to determine how the engineman handles the air brake equipment. A signal valve is located directly above the clock. An emergency valve is located in

the left corner of the cupola. The locomotive headlight generator furnishes the current to light the car.

The chart, illustrated, is that of a test which was run on November 22, 1927. The maximum tractive force of the locomotive, equipped with a tender booster, is 57,800 lb. At a speed of seven miles per hour, hauling 1,496 tons, the chart shows a drawbar pull of 37,500 lb. The booster was then cut in, which increased the drawbar pull to 49,000 lb. The speed dropped to four miles per hour and then the engine began to slip. At three miles per hour, the booster was cut in and it will be seen that the locomotive began to pick up speed.

The records are made on a regular wheel gage press recording chart and values for speed and drawbar pull are read by applying suitably calibrated scales to the chart.

The airbrake equipment in the car

The remainder of the car in which the dynamometer equipment is installed is used as an air brake instruction car. The photograph of the air brake equipment used on the engine shows the old style A-I equipment, automatic and straight air equipment, E-T equipment with B-6 and M3a feed valves, an old style signal valve with a reducing valve, a new style signal valve used with E-T equipment and an engine and a tender brake cylinder.

Another view shows a Baker valve gear model, a sectional model of a freight car brake equipment, the same equipment in working order, a passenger car brake cylinder to show the operation of the slack adjuster, sectional models of an injector, a high speed reducing valve, steam heat regulating valve, a lubricator and a C-6 feed valve and whistle reducing valve.

On the opposite side of the car, ten air brake cylinders are piped to show how the equipment operates on a ten-car train. A gage has been placed on each of the ten cylinders to show the auxiliary and brake cylinder pressures. All the piping is carried underneath the car.

* * *



Photo Courtesy Boston & Maine

Back in the seventies center-draft oil lamps were the last word in car lighting

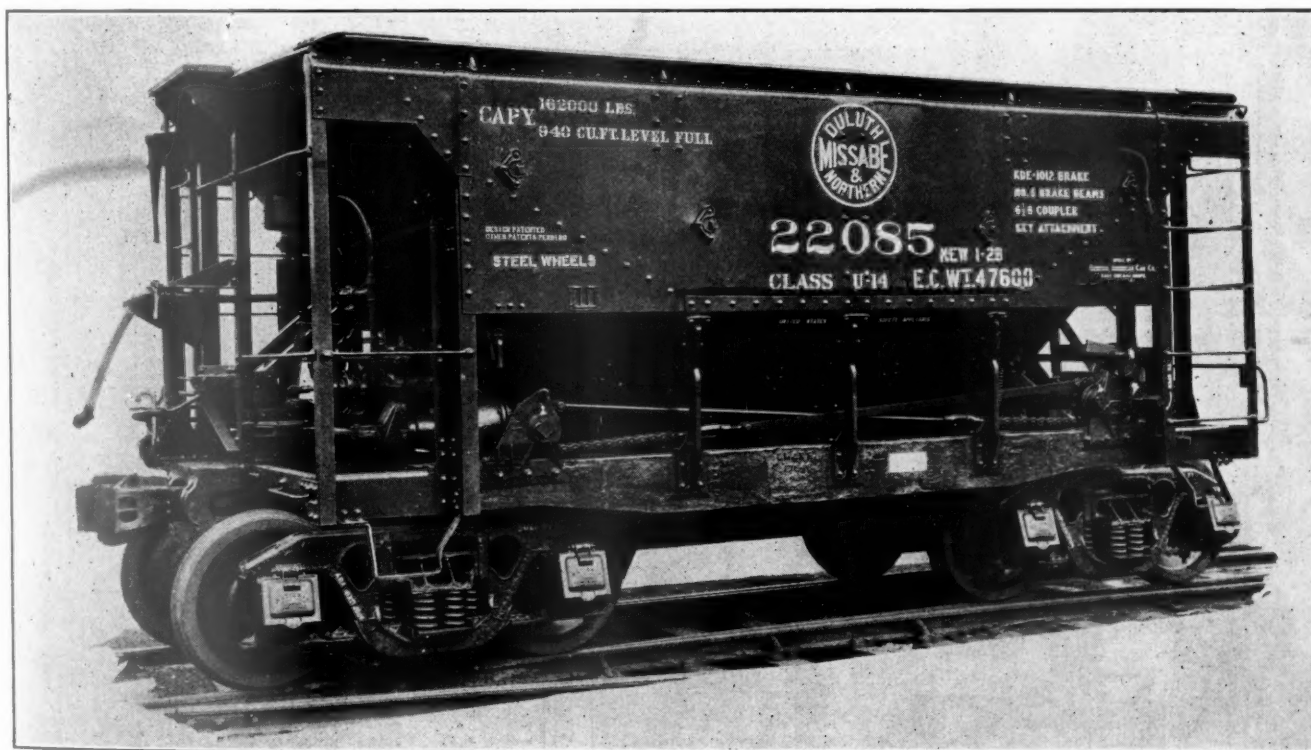


Cast steel underframe ore car

One-half of recent order for 250 high-capacity ore cars for the D. M. & N. have one-piece cast frames

THE large fleet of ore-carrying equipment operated by the Duluth, Missabe & Northern has been increased recently by the addition of 250 cars of 81-tons capacity each. One-half of the cars, known as the U-15 class, have fabricated steel underframes and were

tate handling ore from mines to docks, not only on account of their increased unit carrying capacity but because of improved self-clearing features, rigid construction and convenient door operating mechanism. Unusual strength and rigidity are incorporated in the

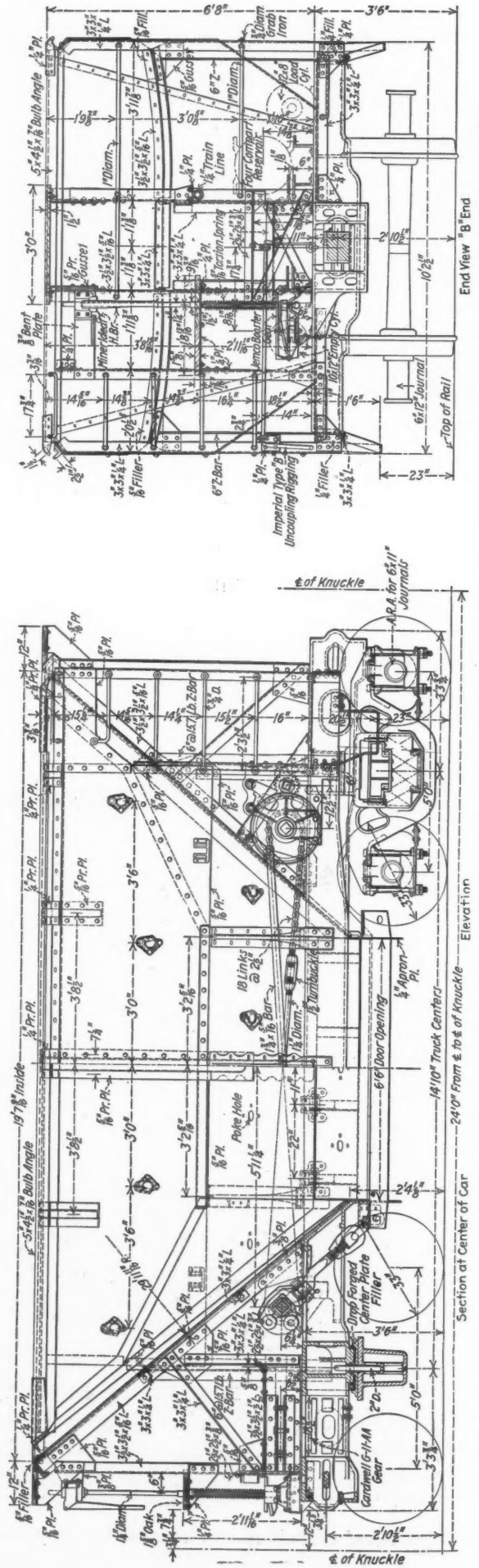
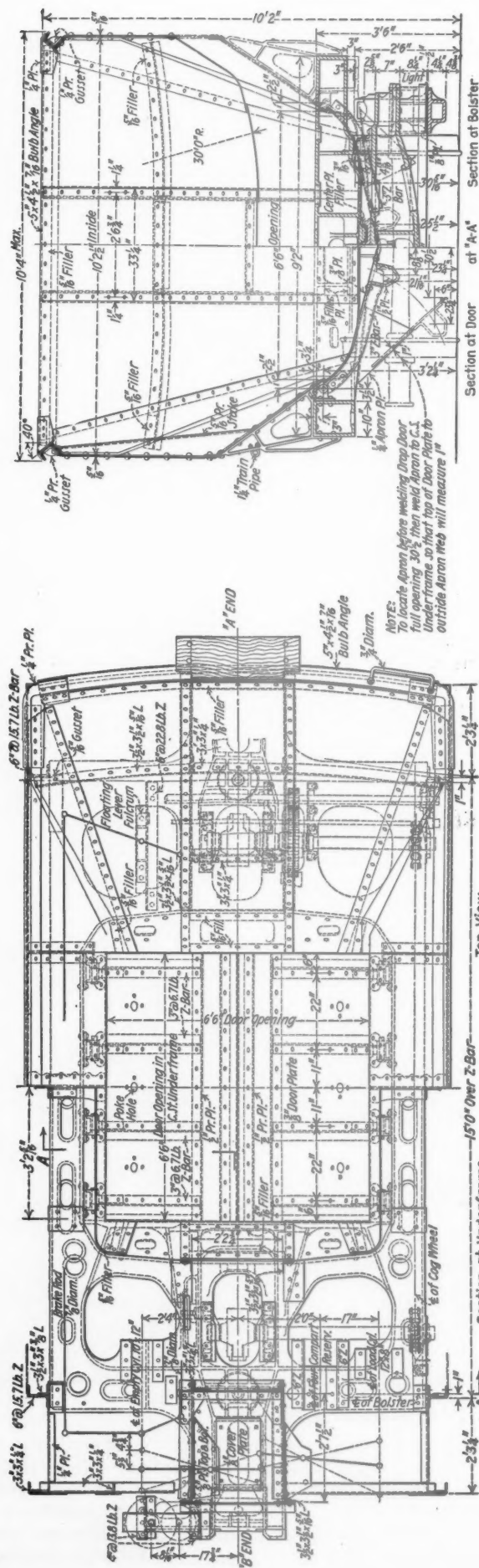


D. M. & N. ore car built by the General American Car Company

built at the Hammond works of the Standard Steel Car Company. The other half, known as the U-14 class, have one-piece cast steel underframes and were built at the East Chicago plant of the General American Car Company.

It is predicted that these new cars will greatly facili-

design since the method of loading ore by steam shovels, which work at high speed, requires dropping as much as 15 tons of ore from the dipper into the cars from a considerable height. On account of dock pocket spacing the overall car length is limited and, although previous designs of cars carried much less tonnage, extend-



General arrangement of high capacity ore car with cast steel underframe built by the General American Car Company for the Duluth, Missabe & Northern

ed investigation and preliminary designing showed the practicability of providing 81 tons capacity in a 24-ft. car.

The general dimensions of the car are as follows:

Length, center to center of coupler knuckles	24 ft. 0 in.
Length over striking castings	21 ft. 5½ in.
Length inside body	19 ft. 7½ in.
Length, center to center of trucks	14 ft. 10 in.
Length of drop door opening	6 ft. 6 in.
Length of truck wheel base	5 ft. 0 in.
Width, overall, maximum	10 ft. 4 in.
Width inside body	10 ft. 2½ in.
Width of drop door opening in body	6 ft. 6 in.
Height from rail to top of body, maximum	10 ft. 2 in.
Height from rail to top of underframe	3 ft. 6 in.
Height from rail to center line of coupler	2 ft. 10½ in.
Height from rail to truck center plate friction surface	2 ft. 2¼ in.
Weight (Class U-14)	47,600 lb.

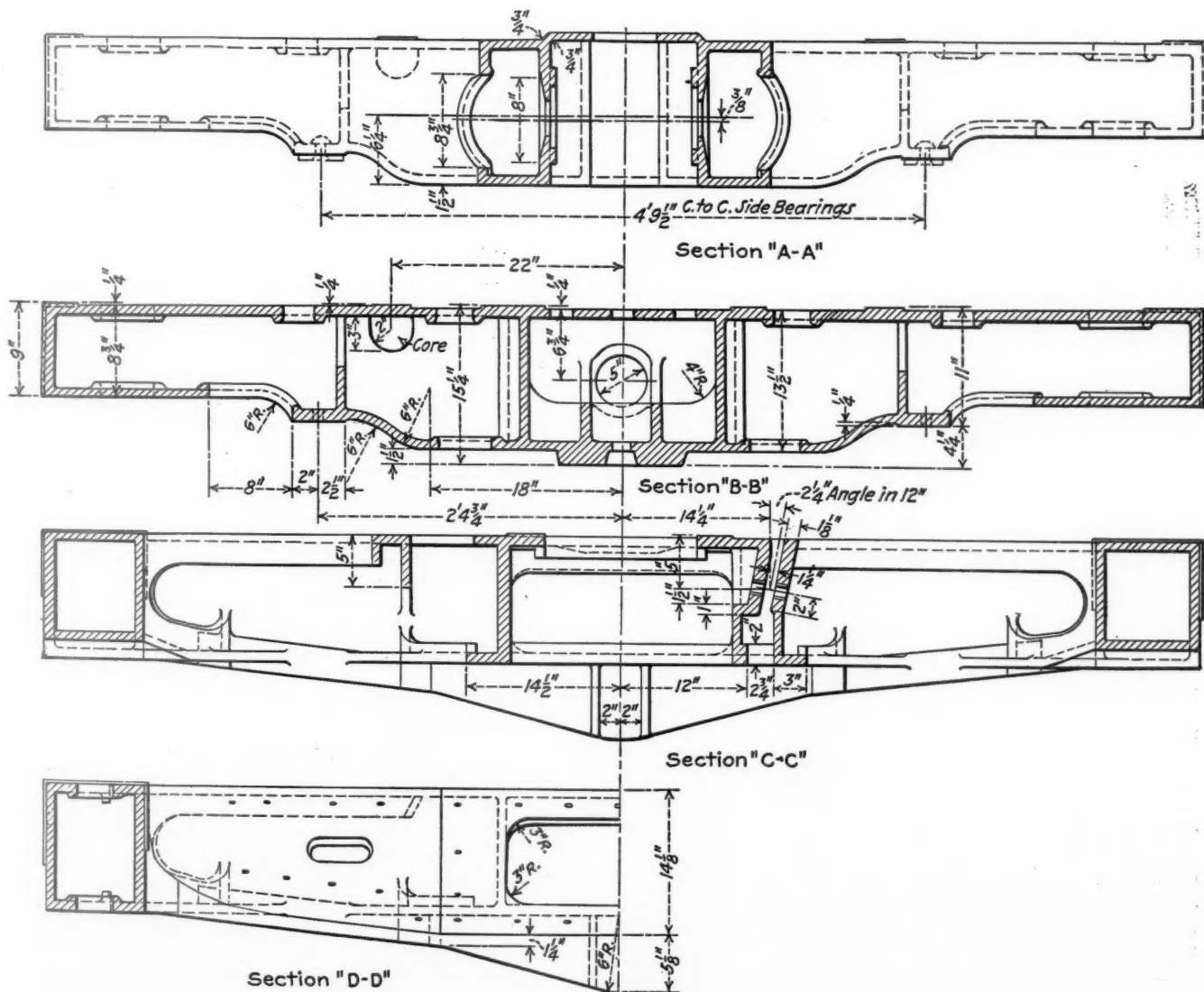
Cast steel underframes applied

With a view to making an extensive test of the advantages of cast steel underframe construction for cars in this kind of service, the U-14 class cars are pro-

vided with Commonwealth one-piece cast steel underframes with integral striking plates, front coupler carry irons, front and rear draft lugs, center braces, bolsters and center plates. Pads are machined for the application of door hinges, side stakes, slope plate supports, air brake cylinders, and fulcrums. It is anticipated that this form of underframe construction will be conducive to strength, resistance to corrosion and consequently, to long life; in fact, experience may prove that each frame will outwear more than one superstructure.

The trucks are provided with Dalman type cast steel side frames, 6-in. by 11-in. journals and rolled steel wheels. The bolsters are of cast steel with separately cast and riveted dead lever fulcrums, furnished by the American Steel Foundries. Side bearings are of the Miner rocker, roller type. National Malleable journal boxes with coil spring type lids are provided.

Other specialties include A. R. A. type D couplers with 6½-in. by 8-in. shanks; Imperial type B uncoupling device, furnished by the Union Metal Products Company; Cardwell G-11-AA draft gears; Miner Ideal operating ratchet hand brake with Jemco booster gear; Ajax No. 6 truss type brake beams with Creco four-point supports and Schaefer drop forged bottom connections.



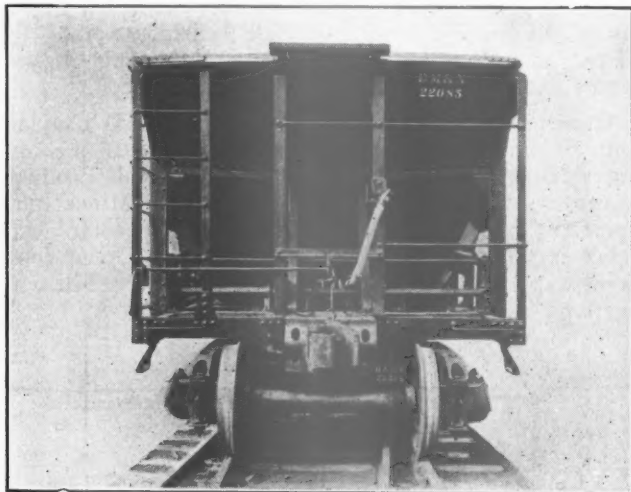
Typical sections through the cast steel underframe—Section AA, in front of the bolster—Section BB, through the bolster—Section CC, between the bolster and the end of the hopper—Section DD, through the hopper space

vided with Commonwealth one-piece cast steel underframes with integral striking plates, front coupler carry irons, front and rear draft lugs, center braces, bolsters

The car superstructure is built of heavy plate structural shapes arranged to afford complete and rapid self-clearing of the lading at the docks into pockets

beneath the tracks, from which pockets the ore is discharged into boats. As shown in the illustration, eight wickets are provided on each side of the car for the insertion of a bar or steam pipe to loosen ore in the event that freezing causes partial clogging or stoppage.

In the construction of the body, the side girders are each composed of a 5/16-in. open hearth steel vertical plate, and a 5/16-in. bottom plate sloping 55 deg. toward the center of the hopper. The side top members are



The end construction of the car

reinforced Carnegie bulb angles, 5 in. by 4½ in. by 7/16 in., tilted to provide a 50-deg. slope, and extending the full length of the car. Two side stakes per car are located inside of the center of the hopper, being made of 5/16-in. plate pressed to U-shape and extending through the vertical depth and portion of the slope sheet and riveted to cast steel supports, three of which on each side of the car are provided for side slope sheet reinforcement. The end slope sheets, of 5/16-in. open hearth steel, are reinforced laterally by 3½-in. angles extending from the center end braces to the side Z-bar stakes and riveted to the end slope sheets. Two slope braces on each end are made of 3½-in. angles extending the full length of the sheet near the center and connected by 5/16-in. gussets to vertical and diagonal angles thus forming an end truss.

The bottom drop doors are made of ¾-in. open hearth steel plates, there being two on each car, reinforced by longitudinal ½-in. pressed U-shaped beams, and laterally by 3-in. Z-bars. The door plates, which have flanges on three edges, are formed to an 18-in. radius tangent to the hinges.

Effective door-operating mechanism

The door-operating mechanism is of the latest design developed by the Enterprise Railway Equipment Company for maximum convenience and effectiveness in operation. The two doors, hinged on the side sills, are arranged to close by swinging upward toward the center line of the car. At the inner corner of each door, a point of attachment is provided and connected by a suitable link with adjustable eye to an equalizer designed to give an equal closing pull on each door, irrespective of slight warping or irregularities in the door construction. The equalizer is pivoted on a hanger which in turn rests above a door-operating shaft when the mechanism is in closed position and provides a positive lock. There are two door-supporting shafts, one at each end of the car, connected through a system of

rods and heavy link roller chains. A large gear mounted on one of the door-supporting shafts has lugs on each side of its hub which engage with clutch collars on the shaft. This gear is driven with a four to 1 gear reduction from an operating shaft extending from side to side of the car to permit operation from either side. The latch pawls and dogs are mounted on separate shafts also extending across the car so that releasing them on one side will also effect a release on the other side.

To open the doors, either of the latch dogs is disengaged from the latch pawl, the latter being hooked up with the latch dog and the operating lever applied to the end of the shaft. By turning to the right until the lugs on the gear wheel engage the clutch collars on the door-supporting shaft, opening of the doors will take place. Lost motion, provided by the use of the clutch collars, permits the doors to be dropped with safety to the operator. In closing the doors the wrench is worked until an indicator, provided on the ends of the mechanism shaft, registers with indicating lugs on the shaft bearing.

Braking is accomplished entirely from one end of the car by means of a Westinghouse empty and load brake. The equipment includes one "empty" cylinder, 10 in. by 12 in.; one "load" cylinder, 12 in. by 8 in.; one four-compartment air reservoir, equipped with special fittings; one changeover valve, arranged for operation from the ground on either side of the car; one triple valve, arms, handles, levers, rods, etc. The braking power is calculated on the basis of 90 lb. per sq. in. air cylinder pressure, the car being braked to 60 per cent of its weight and 40 per cent of its loaded weight. The 1¼-in. brake pipe passes on one side of the hopper and, for convenience in this particular service, is brought at the ends to a height of 6 ft. 3½ in. from the rail.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Joint evidence necessary in claim for improper or defective triple valve

On June 8, 1925, the St. Louis-San Francisco cleaned the air brakes on NKP car No. 5893 at which time a K-1 triple valve was applied. The car was delivered to the owners on June 10, 1925. It arrived at the repair shops of the New York, Chicago & St. Louis on January 12, 1926, at which time the owners stated that the air brakes were inspected and it was found that the boss at the port hole for the retaining pipe on the triple valve was broken off on one side and apparently, after being broken, the piece was soldered back but had fallen out again and was missing. The owner contended that this defect existed at the time the triple valve had been applied by the St. L.-S. F. The St. L.-S. F. contended that the work had been properly performed and that the triple valve was in good condition when the repairs were made. It was further contended

that the joint evidence was not obtained within 90 days of the first receipt of the car home, in accordance with Rule 12.

The Arbitration Committee stated that "The car owner failed to obtain evidence of the improper or defective condition of the triple valve within the 90-day limit prescribed in Rule 12. Therefore, the St. Louis-San Francisco is not responsible."—*Case No. 1545—New York, Chicago & St. Louis vs. St. Louis-San Francisco.*

Labor allowance for removal and replacing of slat bolts on stock cars

The Baltimore & Ohio cars Nos. 11403 and 11458 were repaired by the Mather Stock Car Company on June 26 and August 7, 1926, respectively, on authority of the St. Louis-San Francisco defect cards that covered damage to the metal side door posts and metal side posts on account of being bent. The charges for car No. 11403 contained an item for the R. & R. of 114 slat bolts at .3 hr. each, and on car No. 11458, for the R. & R., of 84 slat bolts at .3 hr. each. The St. L.-S. F. contended that the labor on these bolts should be .15 each as per item 249-A, Rule 107. The Mather Stock Car Company contended that the items rendered were correct according to Rule 109, Item 7.

The Committee sustained the bill of the Mather Stock Car Company.—*Case No. 1544—St. Louis—San Francisco vs. Mather Stock Car Company.*

Credit for second-hand, cast iron, 625-lb. wheels cast prior to July 1, 1924

The Texas & Pacific changed the wheels under Chicago & Eastern Illinois car No. 35870 on June 12, 1926, on account of one wheel being burst in the plate. The opposite wheel removed the casting date for which was August 17, 1911, was in good condition. The T. & P. applied two second-hand wheels and rendered a material charge to the amount of \$6.10 which represented the value of two second-hand 60,000-lb. capacity wheels, less the credit for the two scrap, 60,000-lb. capacity wheels. The C. & E. I. contended that the second-hand value should have been allowed for the wheel removed in good condition, basing its claim that there is no A. R. A. rule that would condemn a 60,000-lb. capacity second-hand wheel, weight 625 lb., when cast prior to June 30, 1924. The T. & P. stated that the charge of \$6.10 was based on the difference in value of two second-hand A. R. A. standard 650-lb. wheels applied and two non-A. R. A. standard 625-lb. wheels removed. The T. & P. also contended that the rules prohibited use of the former design of 625-lb. cast iron wheels if cast prior to July, 1924.

The decision of the committee was that "The rules do not prohibit the use of the former design 625-lb. cast iron wheels, if cast prior to July 1, 1924, and therefore, the contention of the Chicago & Eastern Illinois was sustained."—*Case No. 1546—Chicago & Eastern Illinois vs. Texas & Pacific.*

Car damaged by trespassers uncoupling a string of cars

St. Louis-San Francisco box car No. 30623, was damaged on the lines of the Chicago, Rock Island & Pacific, August 16, 1926; the principal damage consisting of two center sills, four intermediate sills, one side

sill, one end sill and one body bolster broken new. The C. R. I. & P. reported that while moving a string of 30 cars, seven uncoupled, running ten car lengths, striking another cut of cars that had been left standing, and causing the damage of the above mentioned car. The seven cars were uncoupled by trespassers crawling over between the cars and tripping the operating lever. There was no rider on this cut of cars. Neither this car nor any of the other cars involved were derailed, cornered, or side swiped. The owner contended that the damage to this car was covered by A. R. A. Rule 32, Paragraph "D."

The Arbitration Committee held the Chicago, Rock Island & Pacific responsible.—*Case No. 1547, Chicago, Rock Island & Pacific vs. St. Louis-San Francisco.*

Responsibility for scrapping a wrong truck side removed

The Louisville & Nashville billed the Chicago, Rock Island & Pacific for \$43.20 and 4.8 hours of labor for one Bettendorf truck side applied to C. R. I. & P. car No. 36302 on October 16, 1924. The repair card showed that the truck side had been changed on account of being broken. The C. R. I. & P. presented the L. & N. with a joint inspection card as per A.R.A. Rules 12 and 13, dated April 17, 1925, showing that the L. & N. had applied a truck which was not standard to the car and that it had been removed on April 8, 1925, at which time the wrong repairs as shown were corrected. The joint inspection certificate together with the L. & N. repair card was submitted to the L. & N. under date of December 2, 1925, requesting a defect card covering these wrong repairs. The L. & N. issued a defect card dated January 22, 1926, to cover one wrong truck side. The C. R. I. & P. included a charge on the authority of L. & N. defect card for labor and material, allowing only scrap credit for the wrong truck side, removed. The owner contended that wrong repairs had been made and that the repairing line should be held responsible for both labor and material. The owner also claimed that Rule 88 protects the car owner when wrong truck side repairs are made.

The decision of the Arbitration Committee was to the effect that "The Chicago, Rock Island & Pacific was justified in scrapping the wrong truck side. Therefore, the contention of the Louisville & Nashville is not sustained."—*Case No. 1548, Chicago, Rock Island & Pacific vs. Louisville & Nashville.*

Application of non-A.R.A. standard axles with wheel seats in excess of standard dimensions

The Missouri Pacific billed the Southwestern Refining Company for \$27, covering change of wheels under the Southwestern's car No. 206, on account of the wheels being slid flat. A charge was also made for new wheels on a 40,000 lb. axle with wheel seats on R. & L. 2, 5 5/16 in. and R. & L. 1, 5 3/16 in., respectively. The repairing line replaced 585-lb. wheels with 650-lb. wheels on a 40,000-lb. capacity axle. The owner contended that the proper weight wheels should be mounted to the proper size axle, namely, 585-lb. wheels to a 40,000-lb. axle, 650-lb. wheels to 60,000-lb. axle, etc., and also that the fact that a heavier wheel was applied should not nullify Interpretation No. 5 to Rule 98.

The Committee did not sustain the contention of the Southwestern Refining Company, stating that "The billing repair cards of the Missouri Pacific show non-A.R.A. standard axles removed and non-A.R.A. stand-

ard axles applied. Interpretation No. 5 to Rule 98 (1926 Code) does not apply."—*Case No. 1549, Southwestern Refining Company vs. Missouri Pacific.*

Renewal of bent parts which could have been straightened

On February 1, 1925, the Chicago & Eastern Illinois made repairs to St. Louis-San Francisco car No. 121,858, removing a bent coupler yoke and applying a new one. A charge was rendered for a new yoke, less scrap credit for the yoke removed. The C. & E. I. repair card showed that the yoke removed could have been repaired. Therefore, the owner contended that the charge should not have exceeded the cost of straightening the yoke removed as per Item 441, Rule 107.

The Arbitration Committee, in its decision, stated that "Bent parts should, as far as practicable, be repaired, thereby avoiding a charge against the car owner for renewal. However, straightening and replacing forgings, instead of renewal, must be subject to the judgment of the repairing line, with due consideration to conditions and prompt return of the car to service. The contention of the St. Louis-San Francisco is not sustained."—*Case No. 1551, Chicago & Eastern Illinois vs. St. Louis-San Francisco.*

Responsibility for owner's defects associated with additional damage by fire

On February 6, 1926, the Chicago Junction Railway made repairs to Missouri Pacific car No. 6570. The A end and also the side sheathing on the left and right side of the car were broken out by shifting of the load. During repairs the car was set on fire by the acetylene torch. In the division of the responsibility for repairs, the repairing line classified all damage to the car by fire as "No Bill," and the defects which previously existed and were not caused by the fire, were classified as the owner's defects under Rule 41. Parts that were damaged on account of the shifting of the load were also classified as Rule 32 defects. The Missouri Pacific contended that owing to the nature of the damage, it would be impossible to differentiate between the owner's and handling line's responsibility.

The Arbitration Committee in its decision stated that "In view of the statement of the Chicago Junction Railway as to the determination of responsibility for repairs on account of owner's defects, per Rule 41, their bill is sustained."—*Case No. 1552, Missouri Pacific vs. Chicago Junction Railway.*

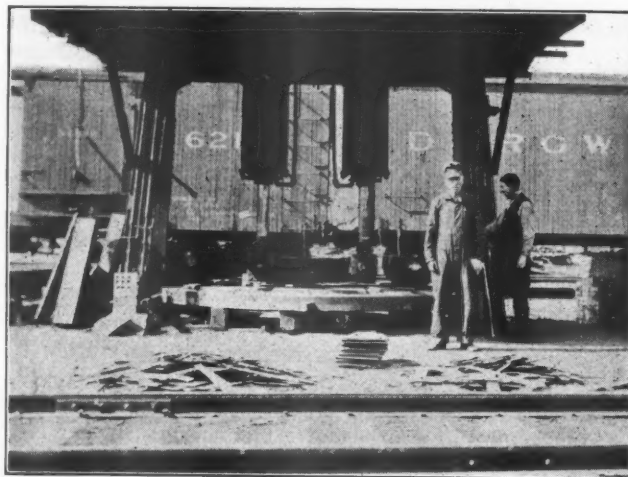
Practical cover for an outdoor machine

By Jos. C. Coyle

A 15-ton air press located outdoors is used for shaping new steel and reshaping all sizes and shapes of old steel car parts. However, during the winter months much time has been lost from snow penetrating the interior parts of the machine and freezing them up.

As it was impracticable to house the machine in the usual manner, on account of the unusual size and length of some of the material to be handled, it was necessary to build a cover over the machine. The framework for the roof was bolted across the top of the heavy frame of

the machine and firmly secured by angle-braces also bolted to the machine frame. The roof, which was laid on this framework, protects the machine from rain and snow

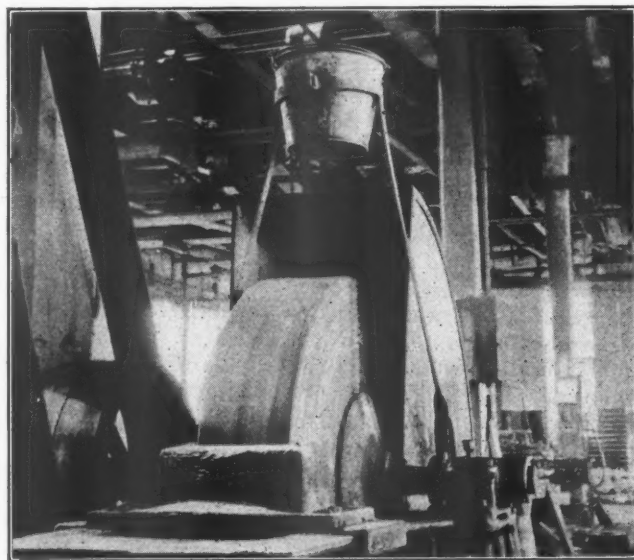


A roof, supported by the press itself, protects it from the worst effects of snow and ice

and at the same time allows perfect freedom for inserting any size or length of material beneath the press.

Device for watering power grindstone

THE device for supplying water to a large power grindstone shown in the illustration has proved its worth many times to the employees who used to be always looking for a bucket to carry water in for



A simple yet effective arrangement for supplying water to a large grindstone

grinding purposes. A steel hoop made to fit the bucket and supported by two long sections of 1-in. by 1/2-in. steel, is riveted to the frame of the grindstone. As the bucket may be readily removed from the hoop, it is used to carry the water as well as to supply it to the stone through a small pet cock soldered in the bottom.



Diner 5138 is the first car to be completely equipped with electrical refrigeration

Ice boxes being eliminated on Milwaukee diners

Twelve cars now in service with partial or complete electro-mechanical refrigeration installed

By W. C. Marshall

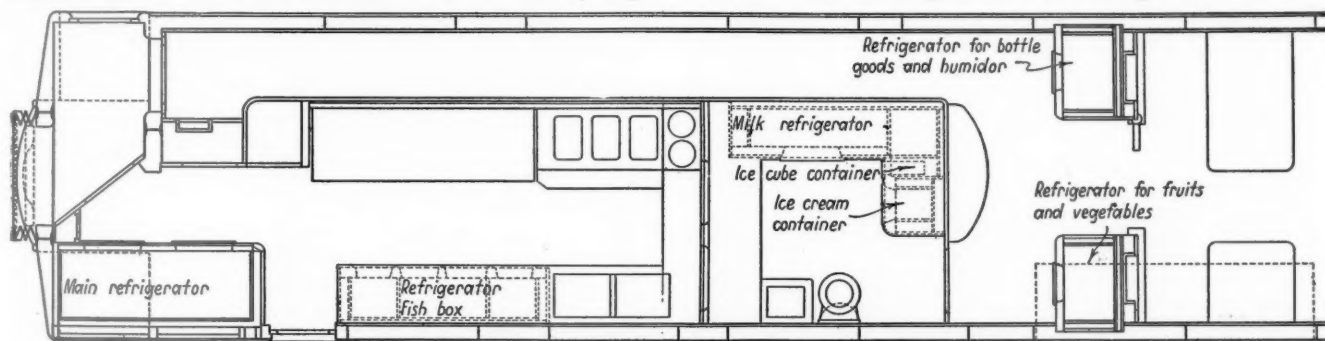
Train lighting maintainer, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis.

SOME time ago, the Chicago, Milwaukee, St. Paul & Pacific started developing a type of refrigerator in which it was hoped certain unsatisfactory operating features of dining car refrigerators could be eliminated. It was decided first to attempt mechanical refrigeration in the main meat refrigerator located in the kitchen of the car. On account of the extremely high

the shelves, cold and warm air ducts were installed, these air ducts extending from the front to the back of the box and from the insulated baffle plates below the cooling unit to the bottom of the box.

Features of refrigerator box

One of the drawings shows the refrigerator construc-



Plan of kitchen end of dining car showing boxes now cooled by electrical refrigeration

kitchen temperature, it was found necessary to increase the insulation and provide better fitting doors to this refrigerator. A minimum of three inches of corkboard was used for insulation and an even greater thickness wherever it was possible. This cork-board was sealed with a non-odorant cement.

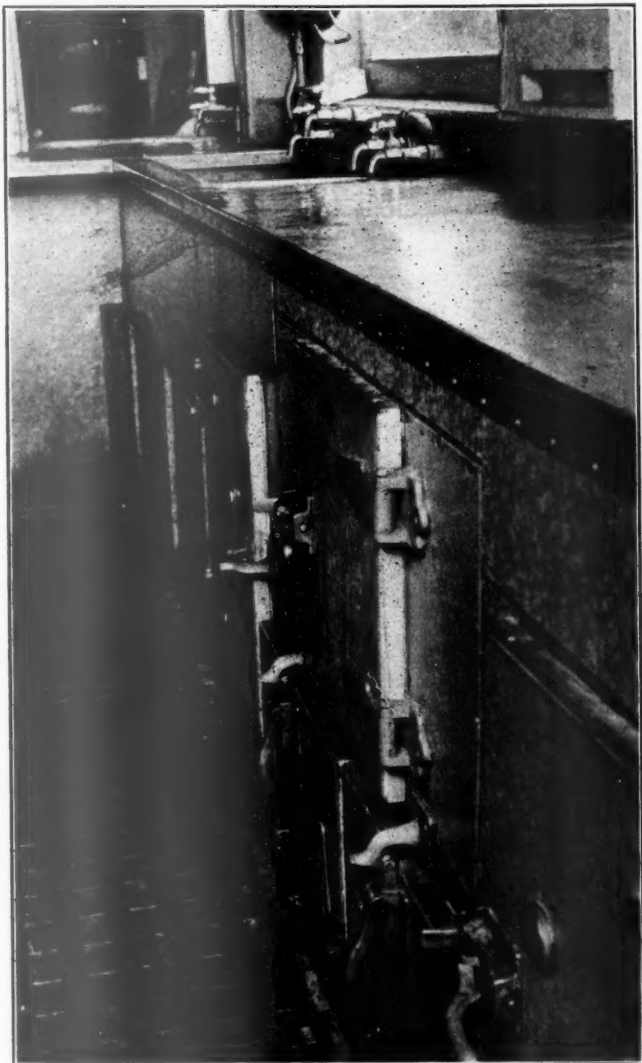
The cooling unit was located in the top of the refrigerator, this being done to control more easily the temperature in all the shelves. In order to eliminate the possibility of stoppage of air circulation through

tion in which the method of air circulation has been changed to meet better the requirements on dining cars. Three air ducts have been provided in this refrigerator extending from the bottom of the insulated baffle plates to the bottom of the refrigerator. One air duct is located in the center and the other two on the sides of the box. The air passing through the fin coil is cooled and carried downward through the center air duct to the bottom of the box. About six inches from the bottom of the center or cold air duct is a perforated plate. The

across the condensing coils. On the more recent installations, the compressor unit compartments have been located under the car with the condensing coils isolated in a separate compartment and open to the outside air. In this manner the coils are kept at a lower temperature and the compressor can be operated at lower pressure. By this arrangement the operating time of the com-

pressors or drawers so located as not to allow any air circulation over the fish. This was done to prevent the fish from losing their moisture. The cold air from the cooling fins passes on two sides of these fish drawers and then up through the shelves used for other sea foods. It has been found that in this manner fish can be kept without ice for from 8 to 10 days. The unit is so adjusted as to keep the fish drawers at about 33 deg. F.

Fig. 1 shows the construction of the main kitchen refrigerator. The cooling units in the two kitchen refrigerators are taken care of by one of the two $\frac{1}{2}$ -hp. air-cooled compressor units located under the car.



Counter refrigerator in the kitchen where fish is kept

pressor was decreased. A $\frac{1}{2}$ -hp. air-cooled compressor unit was used to take care of the single box installations. There are seven dining cars now so equipped and all work satisfactorily. These cars have different types of axle generators of from three to four kw. capacity and are equipped with two sets of 300-a.h. lead batteries connected in parallel.

Complete mechanical refrigeration

During September, 1927, we turned out the first dining car completely equipped with electro-mechanically operated refrigeration. The main kitchen refrigerator is the same as previously described, the cooling unit being a fin coil located in the top of the refrigerator. In fact, there are no brine tanks used in any of the refrigerators or chill boxes in this installation.

The counter fish box located in the kitchen is insulated with three inches or more of cork-board and is equipped with side doors. The fish are kept in metal



Bottle goods locker with four ice cube trays in cooling unit

The pantry refrigerator, ice cube storage bin and ice cream cabinet are built in the counter. These are all equipped with side doors. The milk and butter chill box has its cooling unit in the corner of the counter as shown in the general floor plan. This fin coil or cooling unit takes care of the cooling of the milk and butter compartment, and also the ice cube storage bin and is separated from the two compartments by insulated baffle plates extending from $2\frac{1}{2}$ -in. above the floor to within 3-in. of the top. The 6-in. of insulation on the kitchen end of the counter is necessary on account of

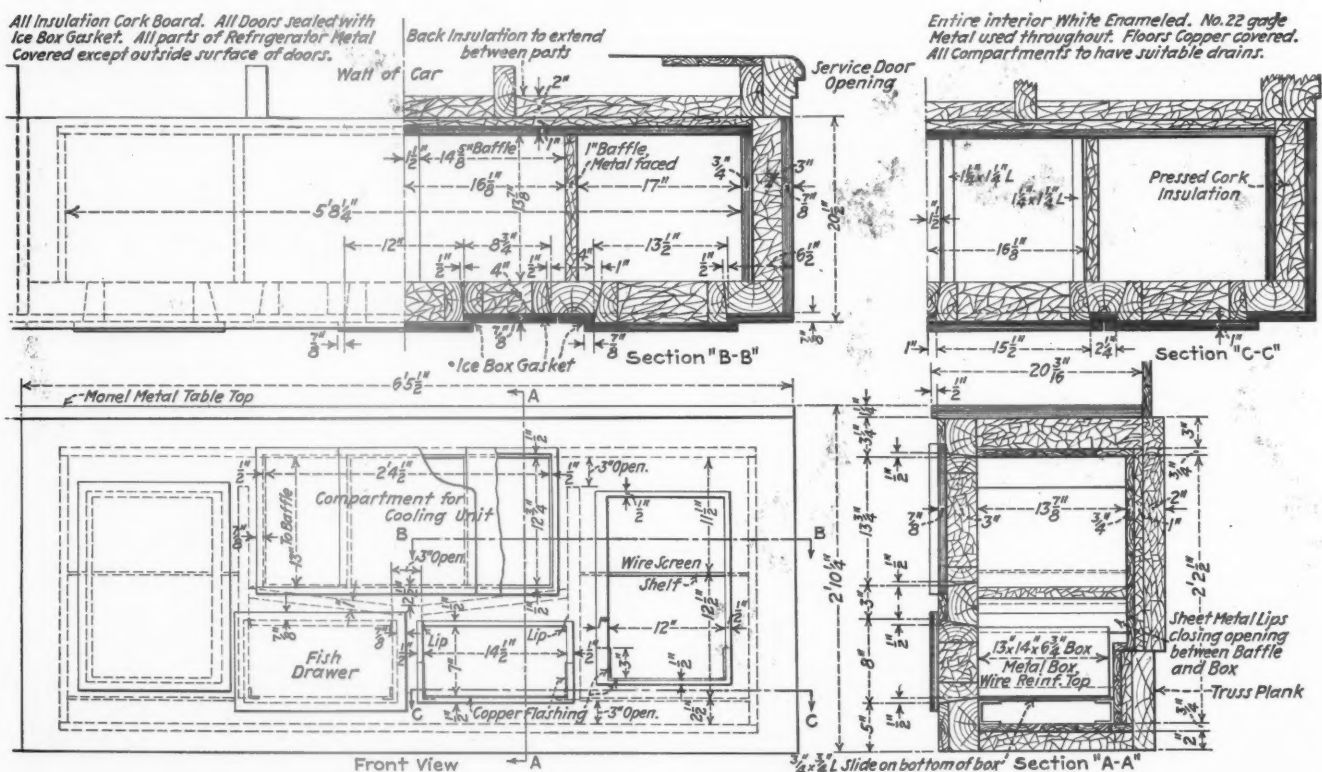
this end of the counter being next to the hot steam table.

The ice cube bin is a metal container sloping down at the back for drainage, the door of which hinges at the bottom. Adjacent to the ice cube bin is the ice cream cabinet which is insulated with from four to six inches of cork-board. The cooling unit is a coil in which the metal container has been placed for holding brick ice cream. The temperature of the milk and butter compartment is held at from 40 to 42 deg. F., the ice cube bin at about 34 deg. F., and the ice cream cabinet at about 3 deg. F. above zero.

The two chill lockers located in the main body of the car as shown in Fig. 2 take care of the bottle goods, fruit and vegetables. The cooling unit in each of these two lockers is equipped with ice cube trays capable of

Compressor units are mounted beneath car

It has been found that the proper location of the compressor units and condensing coils is vital to the successful operation of the system. As shown in Fig. 3, the condensing coils have been removed from the compressor frames and located in a compartment by themselves at the forward end of the unit compartment. As this car is always operated in the same relative direction with respect to the location of the compressor unit, the condensing coils get the full benefit of the air circulation due to the speed of the train. The sides and bottom of this compartment are fitted with heavy mesh screen to allow plenty of air circulation around the coils. These coils are placed in a "V" shape and a 12-in. fan is mounted on the end of the compartment to furnish forced ventilation while the car is not in motion.



Details of mechanical fish box refrigerator

manufacturing 96 ice cubes at one freezing, thus giving a capacity for the car of 192 ice cubes per freezing cycle. Under normal operating conditions, three freezing cycles every 24 hr. is sufficient to take care of the needs of the car. In the bottle goods locker, the ice making unit is located above the insulated baffle plate. Metal frames equipped with properly spaced rods carry the bottle goods. In the fruit and vegetable locker, as in the bottle goods locker, the ice making unit is placed above the baffle plate. The air circulation is carried out the same as in the main refrigerator in the kitchen. The temperature of these two lockers is held at about 45 deg. F.

Wherever possible the fronts of all the refrigerators in the car are made hollow and filled with cork-board to cut down heat leakage and all of the doors are fitted with compression strips to make the refrigerators as near air tight as possible. All of the cooling units in the refrigerators in the pantry and the main body of the car are taken care of by the other 1/2-hp. air-cooled compressor unit located under the car.

This fan is so connected that it cuts in or out with either compressor unit.

The two compressor units are located in a compartment adjacent to that holding the condensing coils. The front of this compartment is so constructed that it can be easily removed. Perforated service doors have been constructed in this front to allow easy inspection and access for adjusting the apparatus. The compressor unit operating the refrigerators in the pantry and main body of the car is equipped with an automatic regulating valve. This is done to obtain the variation in operating temperatures between the ice cream cabinet and the other refrigerators connected to it.

Electrical control and operation

The 2 1/2-hp. motors driving the two compressor units are connected directly to the storage battery through separate circuits. These two circuits are equipped with knife switches and fuse blocks in the switch locker inside the car. Each motor has a service switch in the

unit compartment under the car. A pilot light connected across each motor circuit between the fuse block and the automatic switch is located on the front of the main kitchen refrigerator. These pilot lights burn continually except when the circuits are opened by the switches or blown fuses. The automatic switch connected in each motor circuit is operated by a pressure bellows connection in the suction line of the compressor and is indirectly operated by the temperature in the refrigerators.

This dining car is equipped with a 5-kw. Safety axle generator and a 600-a.h. Iron Clad Exide battery. The refrigerating apparatus is standard Frigidaire equipment. This car has now been in service for slightly over four months and so far has needed only a few minor adjustments. From tests taken on this completely refrigerated car and the other dining cars which are equipped with the single mechanically-refrigerated boxes, it was found that the running time of the compressors is about 40 per cent. This running time increases during the warm weather to about 65 per cent and decreases to about 20 per cent during cold weather. So far the operation indicates a considerable saving in food, and the elimination of ice.

Material support for a drilling machine

By Jos. C. Coyle

LONG heavy pieces of material are awkward to handle on a drilling machine. The roller feeder shown in the illustration, which is of light construction, enables the operator to move such pieces with comparative ease. The frame is made of $\frac{1}{2}$ -in. by $1\frac{1}{2}$ -in. steel. Two sections, 5 ft. in length, are bent in a triangular shape to form the legs of the frame. Two 2-ft. lengths of the same material, riveted at each end to the legs, form



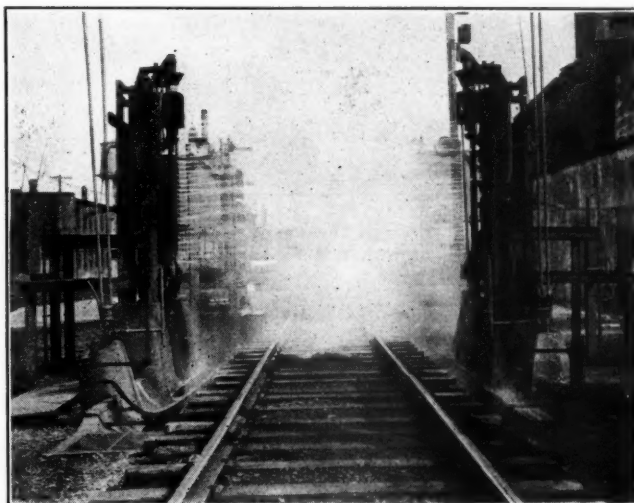
A portable, adjustable material support for a drilling machine

lengthwise braces while two other pieces of material, 14-in. in length, also riveted to the legs, brace the ends.

Two 3-ft. lengths, perforated with holes every 6-in., support the roller. These pieces pass through slots in the top of the legs and the end braces, thus making it possible to adjust the rollers to any desired height.

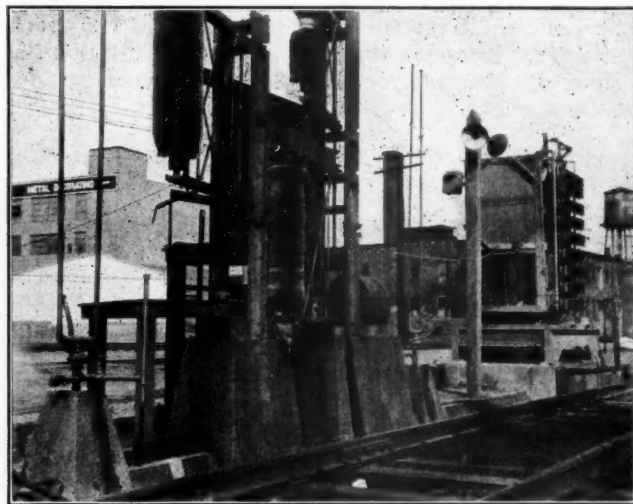
B. & O. improves its car washing machine

THERE appeared in the March, 1928 issue of the *Railway Mechanical Engineer*, page 142, a description of a passenger car washing machine which was installed by the Baltimore & Ohio at its Tenth street



Rear view with the sprays in action

coach yard, Pittsburgh, Pa., in the fall of 1927. As was stated in the article, the machine was originally constructed and patented by the Pittsburgh Street Rail-



The rotating brushes perform the final cleaning operation

ways Company for washing street cars, and was later adapted by the Baltimore & Ohio to meet steam railroad requirements.

The Baltimore & Ohio has been continuing its experimental work toward developing a completely satisfactory machine for washing passenger coaches and has installed a second machine at its Camden passenger

coach yard, Baltimore, Md. This machine which is shown in the three illustrations, is a considerable improvement over the Pittsburgh installation. In addition to the three rotating brushes, the installation of which is practically the same as on the Pittsburgh machine, a



The cars pass first through the vertical scrubbers, shown in the foreground, and thence to the rotating brushes

vertical scrubber has been added which assists materially in the removal of grease and heavy, caked dirt.

This vertical scrubber consists of a series of nine brushes that move vertically up and down against the side of the car. The train of cars is moved through the vertical scrubbers first and thence through the rotating brushes.

As each car enters the machine it is sprayed with a weak solution of oxalic acid which is reclaimed and used over again. The vertical scrubber then cleans the sides of the car, after which it is sprayed with water, passed through the rotating brushes and finally rinsed with a water spray.

This installation at Baltimore has been made for experimental purposes and as soon as the development work has been completed, will be located in the coach yard so that incoming trains can be passed through the washing machine and routed direct to the passenger station for loading.

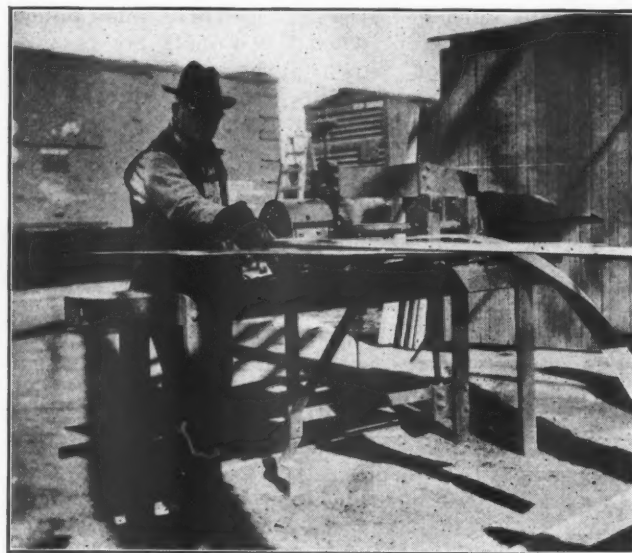
Power sheer for cutting sheet metal

DURING the recent rebuilding of a series of freight cars at the Denver shops of the Union Pacific, it was found necessary to cut a considerable amount of sheet metal outside of the shop. To speed up the work, a motor driven cutting machine was devised.

A No. 4 air motor, with a mandrel about 4 ft. long, was mounted on a steel bench, 6 ft. long and 2½ ft. wide. At the extreme end of the mandrel, two discs, ½ in. thick by 4 in. in diameter, were adjusted so that the sheets of metal, as they passed between the discs, are sheared by the square edges of the discs, one of which was secured on the live mandrel, the other on an idler. The discs were covered with a guard for safety.

To cut down the speed of the motor so that the metal could be properly manipulated by hand as it passed through the discs, a small brass plate contain-

ing a 1/16-in. orifice, was placed inside a nut and swivel union in the air line.



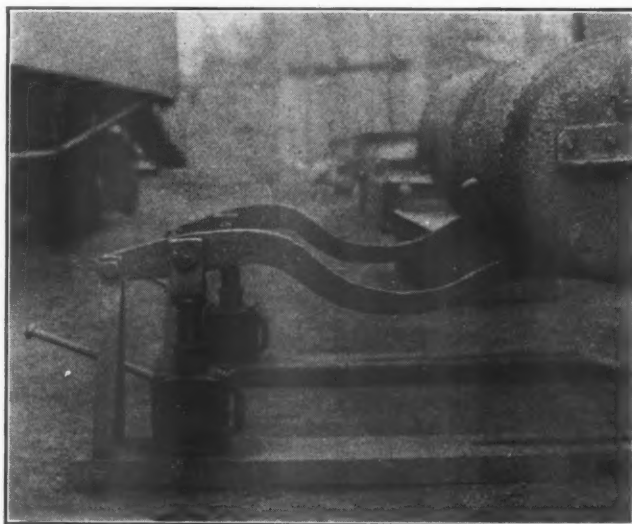
Two revolving discs are used to cut the sheet metal

A device for placing gas tanks under passenger cars

By P. McNamara

General car foreman, Union Pacific, Denver, Col.

THE illustration shows a handy device for placing gas tanks or air reservoirs under passenger cars. It consists of two car oilers' jacks mounted on two 2-in.



Two journal box jacks are used to raise the tank in position

oak planks, each of which has a slot in the center on the far end so that the end of the arm for raising the tank can be lowered flush with the plank, thus allowing the tank to roll into place easily. These two jacks and arms are placed underneath the car in which position the tank may be raised and held in place while being fastened to the car.



Forging furnaces operated with powdered coal*

This method has reduced maintenance costs and number of furnaces required

By W. Clifford Rehfuss

Assistant superintendent of blacksmith shop, Baldwin Locomotive Works, Eddystone, Pa.

CONSIDERABLE attention has been given to the use of powdered coal for power generation purposes under boilers, but its use in small industrial furnaces offers an opportunity for considerable discussion and development. The plant which is used at the Baldwin Locomotive Works for the preparation of

is dropped from cars into a large track hopper from which it is conveyed to a roll crusher by a belt conveyor. Here it is reduced in size so that 90 per cent will pass through a half inch mesh. From the rolls it is elevated in a bucket conveyor or elevator, passed through a magnetic separator to remove tramp iron and delivered to a screw conveyor feeding into a revolving cylindrical dryer of the direct heat type. From the dryer it is conveyed to two pulverizers of the Bonnot type which are motor driven. An air separator, pro-

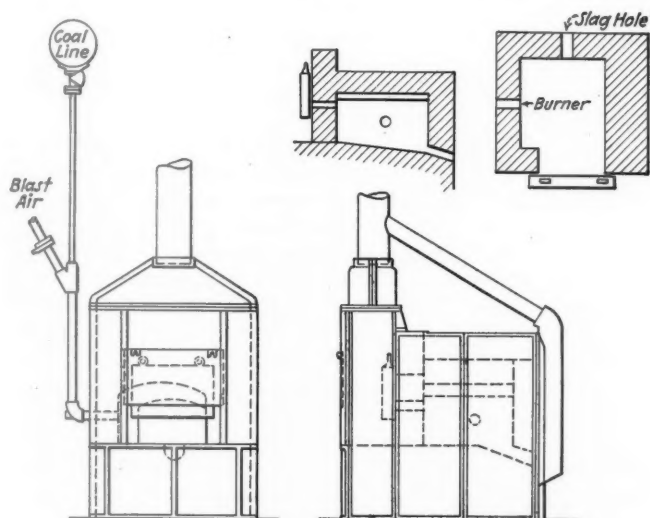


Fig. 1—Old style powdered coal furnace

the coal, uses the Holbeck system and was installed by the Bonnot Company. It has a capacity of ten tons per hour.

A description of the plant

The raw coal, high volatile bituminous run of mine,

* Abstract of paper presented before the Philadelphia Section of the American Society of Mechanical Engineers.

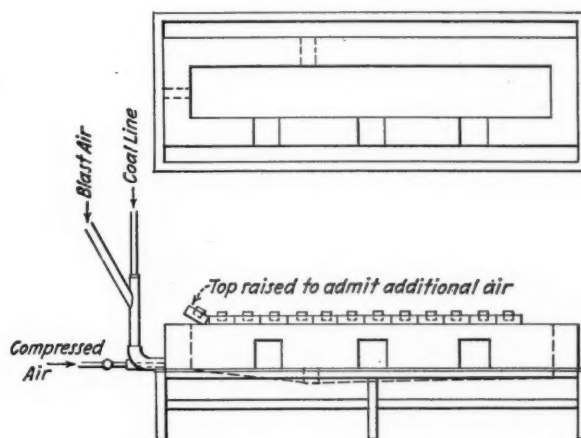


Fig. 2—First trench type powdered coal forge

vided on each pulverizer, keeps the coal from leaving until it reaches a sufficient degree of fineness. For our purpose, 85 per cent passes through 200 mesh and the remainder through a 100-mesh sieve. The degree of fineness is regulated by the velocity of the air going

through the separator and the position of the flues. The air currents are induced by motor driven fans placed above the separators. After leaving the separators, the air currents carry the coal to settling cones, from the bottom of which it falls into closed storage bins provided with vent pipes.

The whole equipment is housed in a structure of steel and hollow tile especially designed to avoid fire

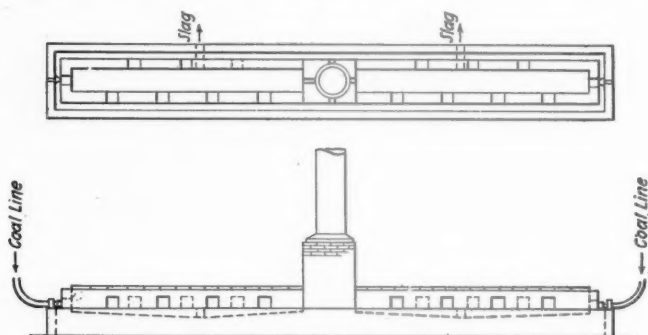


Fig. 3—New style powdered coal forge

hazards due to the accumulation of coal dust around the interior of the structure.

For distribution, the powdered coal is dropped from the storage bins into closed weighing tanks and ejected by means of compressed air through three-inch pipes to the various substations, seven in number. The substations are all alike except in the size of the storage bin and the capacity of the fan.

The substations are located as close to the points of maximum consumption as possible. Each consists of a storage bin feeding through a variable speed screw conveyor into the intake of a large fan. The mixture of coal and air, running about one pound of coal to 50 cu. ft. of air, is circulated through a tapered loop of spiral riveted pipe, which carries the coal to the points of actual consumption. The return from the loop comes back to a settling cone at the substation, thus returning all unconsumed coal to the bin. The returning air is fed back into the fan along with the make-up air coming in through an automatic air valve connected to the motor control on the screw conveyor used as a feeder.

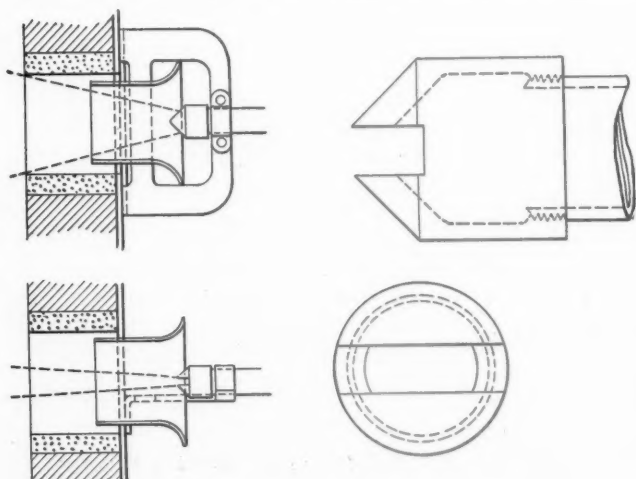


Fig. 4—New style powdered coal burner arrangement

In this way, the mixture of air and coal is automatically kept constant in the circulating line, irrespective of how many burners are turned on or off. The pressure maintained in the loop is about seven ounces.

Early design of powdered coal furnaces

The circulating loop for carrying the coal is placed overhead as nearly in line with the furnaces being served as possible. The individual feed pipes are made short and with no obstructions or pockets, to avoid clogging up in case the air velocity is reduced too much while throttling the air and coal mixture being fed into the furnace. A valve of the butterfly or poppet type is cut into the side of the line above each furnace and controlled by a hand wheel at the furnace. A later improvement involves taking the coal from the top of the loop and the use of special stop-cocks, both at the point where the feed-pipe leaves the loop and at a point near the burner. The top valve is placed in the line for emergency purposes should any of the coal pipes be broken off.

Under the old system of operating, a low pressure blast line was run paralleling the coal loop to furnish additional air necessary for the combustion of the coal. The burner was connected through a Y to both the coal and blast lines, the blast air being controlled through an ordinary blast gate. The furnaces were provided with a slag hole in the rear and an enclosed hood over the charging door. The only outlets for the products of combustion were through the slag hole or under the

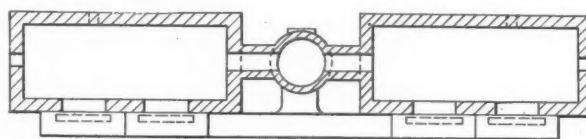


Fig. 5—Two-door powdered coal furnace

charging door, as the hoods only were connected to stacks.

Furnaces of this type, shown in Fig. 1, had been in active operation for the last seven or eight years. They have several objections. The coal and air came into the furnace at such a high velocity that a large proportion of the dust, gases and heat was blown past the hood and into the shop. Maintenance costs were extremely high due to the rapid cutting action of the high velocity flame on the brickwork and the fact that most of the gases and flame must pass under the door. In many cases doors would only last a day or two and the furnaces about one week before heavy repairs were necessary. The use of water in the doors improved their life, but maintenance costs remained exceedingly high owing to the higher cost of such doors and cracking. The heating capacity was not great enough, because the heat was frequently blown out of the furnace by too much blast caused by improper regulation on the part of the operator.

These conditions required serious attention, and about the beginning of February, 1927, we started a series of experiments with the idea of correcting them.

Oil has been and is still being used in a number of our smith shop furnaces, but we are striving to get rid of it as soon as possible, not only because of the higher fuel cost, but also because of the quantities of dense

black smoke and oil fumes that fill the shop where it is used. We have now succeeded in ridding the whole of our west smith shop of oil, a building 400 ft. long by 300 ft. wide, much to the elation of the men who work there.

For forging work coal is much better, because it furnishes a softer and more penetrating heat than the oil and consequently there is a much less tendency to burn the steel.

The trench type powdered coal forge

We have been experimenting on the use of powdered coal in a small pot forge, and this finally led to a trench design which we built as an experiment. This is shown in Fig. 2.

The burner on this furnace had powdered coal, blast

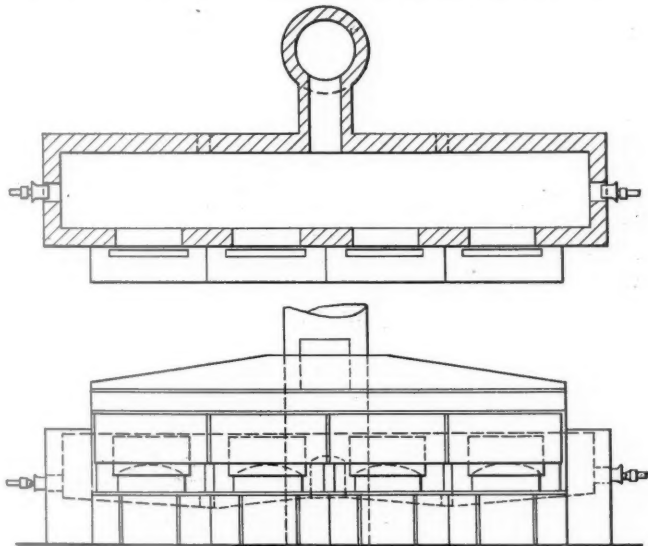


Fig. 6—Four-door furnace

air and compressed air hooked to it so that we could make use of all of the variables. When put into operation we found that air was being sucked in through the first operating door or opening, causing a very noticeable improvement in its operation. The heating capacity of this forging furnace proved so great and its maintenance so small in comparison with the others, that we decided to build a larger one, shown in Fig. 3, with fourteen doors and a burner at each end. A stack was added to the center to remove the dust and gases. It was with this powdered coal forge that we really developed our present form of furnace and system of burning powdered coal, because it gave us an opportunity to study the nature of the flame produced and the combustion conditions.

The first one demonstrated the necessity of admitting additional air near the burner so the new one was built with a circular opening 10 in. in diameter at each end, to take the burner. When first fired up we found that the flame traveled too far without filling the sectional area of the furnace despite the fact that it was only two feet square. A spraying tip was developed with good success, causing the coal and gases to ignite close up to the burner and the flame to have a larger sectional area. The spreading of the gases in this manner caused a great reduction in their velocity, with the result that the scouring action on the brickwork was very materially reduced, and the heat generated had a very much better chance to be absorbed by the furnace walls and the objects being heated.

While operating this forge type of furnace, we found that frequently we could dispense entirely with the

blast air furnished by the auxiliary blast line. Then we had the blast lines disconnected and went after the perfection of our new system.

With seven ounces of air in the coal loop, assisted by a stack, we were well enough equipped to induce the additional air necessary for the full combustion of the coal. The object of the stack is to keep the pressure within the furnace at a low point, near atmospheric, and to remove the products of combustion, dust, etc., so that they will not enter the shop building.

After the removal of the blast lines, we perfected a tip and burner arrangement which we are now using on all of our furnaces. This tip allows the coal to be throttled to a fairly low point without dropping onto the hearth of the furnace and further gives no trouble from clogging or coking. Fig. 4 shows the present form of burner arrangement, the bell mouth opening being reduced to 8-in. in diameter.

Furnaces of various styles were constructed to meet the conditions of forging requirements and shop arrangement.

Type of furnaces now used

The most common design of furnace in use for both steam hammer and drop hammer work is the two-door type shown in Fig. 5. The furnace shells are built up of steel plates and structural shapes and the walls and arches are made up of 9 in. of firebrick throughout. All the doors are of cast iron, with a monolithic lining developed in the course of our experimental work.

Fig. 6 is a sketch of the four-door furnace. This was developed to secure a straight line arrangement of drop hammers, trimming presses and furnaces with economy in space and without undue crowding.

Fig. 7 shows the back to back style, which is really two of the two-door style placed back to back, but built in a single furnace shell with a central air cooled parting wall. This was also done to conserve space and at the same time to secure a special grouping of steam hammers.

The stacks are made of steel, lined with 4½ in. of

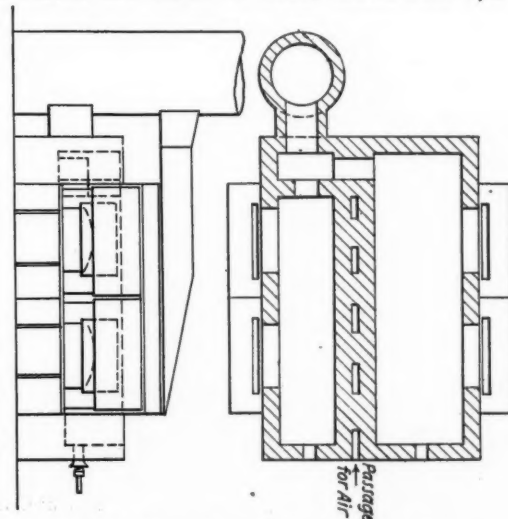


Fig. 7—Two-door back-to-back furnace

firebrick, and are generally about 50 ft. high in order to clear the top of the building. In most cases, the diameter inside of the brick lining is three feet, this diameter being necessary to provide plenty of draught through the outside hoods in addition to the interior flues, there being two furnaces attached to each 36-in. stack. A smaller diameter stack than this is very hard to line and keep clean. This was found through ex-

perience as we have several 24-in. lined stacks on individual furnaces. Cleanout doors are provided near the base of each stack.

Fig. 8 shows the Ajax type of furnace developed for use with two 5-in. Ajax machines. Here a higher temperature is necessary, so the furnace was given a T-shape to secure a uniform temperature across the whole front. It will be noted that the travel of the flame is given a free sway throughout the length of the furnace in all cases. The object of this is to give the

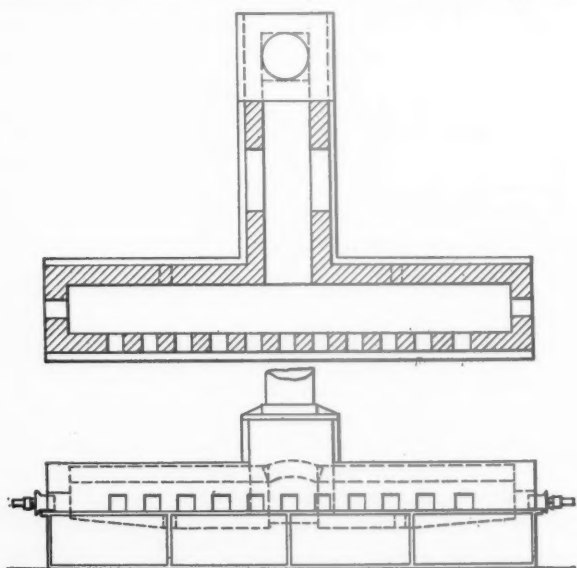


Fig. 8—Powdered coal furnace for 5-in. Ajax forging machines

brickwork a longer life by reducing the erosion effect caused by direct impact.

All flues leading to the stacks are regulated in size so that a small amount of flame comes out around the doors. This keeps the pressure within the furnace at a point slightly above atmospheric pressure and prevents excessive losses of heat in the stack. The low pressure within the furnace permits the injector action at the burner to bring in sufficient additional air for full combustion of the fuel.

Advantages of new furnace designs

We have been operating these furnaces long enough to find decided advantages in our new system. These might be summed up as follows:

Heating capacity has been materially increased.

Maintenance costs have been reduced due to longer furnace life. The average furnace life is now about six months and that of the doors about six weeks.

The temperature of the furnaces is uniformly, about 400 deg. F. on the average, resulting in a larger production per man. In several instances, by actual check-up we were able to get double the production from a hammer unit that we did with the old style furnaces.

Hotter forgings lead to a real saving on dies and a more perfect drop forging.

Removal of the danger of getting burned by puffing (the shooting of flame without warning through the furnace doors). With the old style of furnace accidents due to this cause would occur about once a week, and none have occurred with the new style of furnaces in about 10 months of operation.

The heat is not so great around the furnaces. It is possible when the doors are shut to stand directly in front of them without any discomfort.

Removal of dust and gases from the shop, a decided move in favor of the health of the men.

Reduction of the number of furnaces to about two-thirds of what we had before.

Saving in fuel cost due to the removal of the oil, reduction in the number of burners in operation, and the increase in furnace efficiency.

Removal of all blast lines and blowers. In the case of the West smith shop this meant the removal of six 50 hp. motors with their consequent operation and maintenance costs.

Simplification of the shop and method of furnace operation. The resulting improvement in shop conditions simplifies the labor question when expansion in forces is necessary.

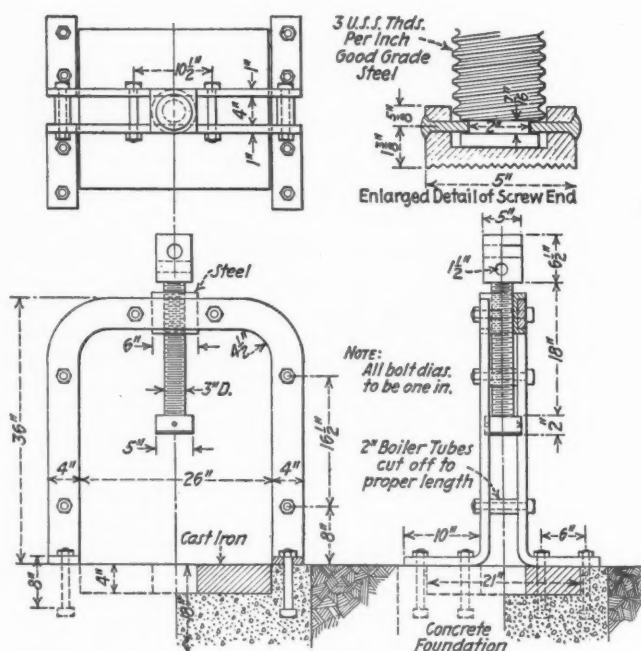
A shop-made bushing press

By H. H. Parker, Jr.

Shop draftsman, Norfolk & Portsmouth Belt Line, Portsmouth, Ohio

THERE are many outlying points on large railroads, such as small repair shops and enginehouses, that are not equipped with a hydraulic or power press. The bushing press shown in the drawing can be easily made in the shop. It has been used in the shops of the Norfolk & Portsmouth Belt Line for a number of years and performs a good job. Since it was placed in service, this road has purchased a hydraulic press, but the shop made press is still in use for smaller classes of work.

It is often necessary in a small shop to renew a rod



Bushing press used for light and miscellaneous work in the shops of the Norfolk & Portsmouth Belt Line

bushing or press in a crown brass, or perhaps press in a main valve bushing of an air compressor. For this class of work, the press will give very good service and considerable power can be developed if it is equipped with a long handle.

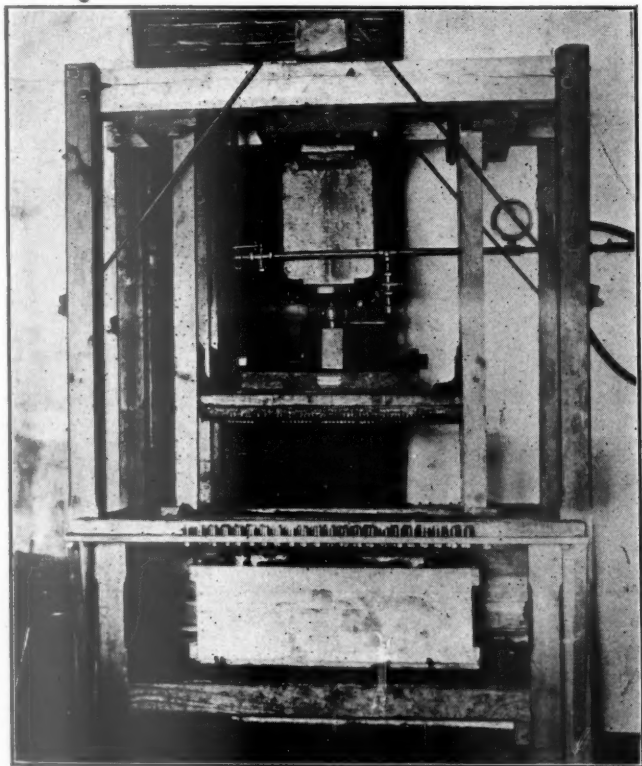
The material needed to construct the press is as follows: one cast iron plate, 25 in. by 25 in., 4 in. thick; a 28-in. by 36-in. concrete foundation 18-in. deep; one steel block bored and chased for a screw; one steel screw 18 in. long, 3 in. diameter, 3 threads per inch, end toggled on; four 2-in. tubes 4 in. long; fourteen 1-in. hexagon nuts; two pieces of iron, 4 in. wide, 1 in. thick

and 10 ft. long; 8 bolts, 1 in. by 9 in., to be sunk in the foundation; six bolts, 1 in. by 7 in., to act as braces; one steel or iron rod, 1½ in. by 8 ft. long, for a handle.

The press should be located as near to the drill press as is possible so as to eliminate unnecessary hauling of rods, driving boxes, etc. It does not require much floor space or foundation; therefore, it can be placed almost anywhere in or around the shop.

Machine for cutting rod cup grease wafers

THE illustration shows an air operated machine, developed in the Waterville, Me., shops of the Maine Central, for cutting hard grease wafers used in locomotive driving rod grease cups. The development of the machine was necessitated when the Maine Central changed over to a hard grease the consistency of which made it impossible to cut it with a knife. The grease



A total of 469 grease wafers can be cut in one operation on this machine

would adhere to the knife blade no matter what method was used to prevent it. It was found that a thin wire under pressure would successfully cut the grease.

The grease, which is shipped in cake form, is cut to convenient sizes for placing in the air-operated forming machine which forms it into long rolls 1½ in. in diameter. These rolls pass from the forming machine onto a metal table covered with heavy oil to prevent the grease from sticking to the metal. The rolls are then cut into 28-in. lengths ready for the wafer cutting machine.

The frame of this machine is made of heavy oak timbers. Over the opening cut in the machine table, are

stretched 67 piano wires, on which are laid seven rolls of grease. These wires are spaced to cut wafers ¾ in. in thickness. The grease is pressed through the wires by the upper platen on the bottom of which are attached seven wood strips which are shaped to conform to the diameter of the grease rolls. These strips contain slots through which the wires pass when the grease is cut. The wood strips are used to prevent adhesion of the grease to the platen. The pressure is applied to the platen by the use of an 8-in. by 12-in. air brake cylinder. A reducing valve is placed in the air line to reduce the shop air pressure to 35 lb.

The 469 grease wafers, cut in one operation, fall into a box located underneath the wires.

Testing air operated motors in the shop

THE illustration shows a rack for testing pneumatic drills and reamers or portable air operated motors of similar design in the shops of the Central Railroad of New Jersey at Elizabethport, N. J. The rack can be adjusted to take any size of motor used



Test rack for testing pneumatic drills and reamers

in the shop. It consists essentially of a Prony brake, a pressure gage, platform scales, and a meter for measuring the air consumption in cubic feet per minute. To test a motor, the spindle is fitted to the Prony brake and the hose is attached to a connection on the rack which leads to the shop air line. A small platform scale for ascertaining the resistance on the Prony brake arm sets on the bench.

The brake horsepower of the motor is calculated from the regular formula for the Prony brake; namely,

$$B. \text{ hp.} = \frac{2\pi l_n (W - W_o)}{35,000}$$

in which

l = the length of the brake arm
 n = the number of r.p.m.
 W = the load on the scales, in lb.
 W_o = the weight of the pedestal and brake arm

All of the known quantities, such as the length of

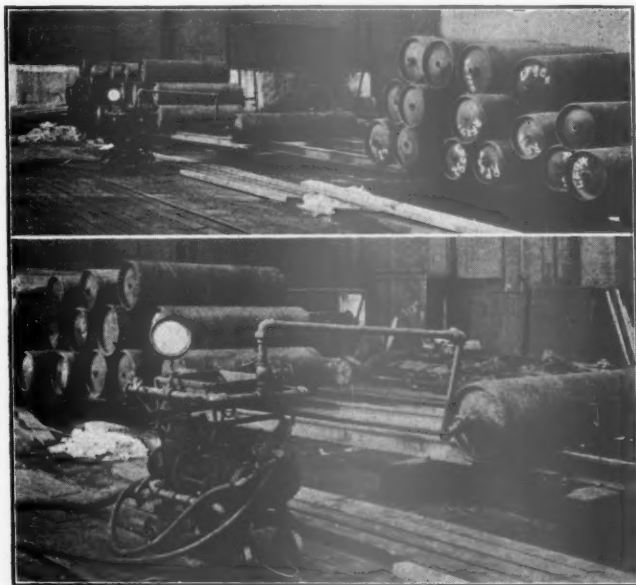
the brake arm and the weight of the arm and pedestal on the scale, were determined at the time the rack was installed. The formula, in which the known quantities have been substituted, is painted in small letters on the rack, for the guidance of the operator.

This rack has proved to be valuable in checking the power, not only of new motors, but of motors that have undergone repairs. All new motors received at the shop are tested on this rack and the results of the test are checked against the specifications by which they were purchased. Each motor coming out of the tool-room after repairs have been made is also tested on this rack to make sure that it develops the required power.

Previous to the installation of this rack, it was a frequent occurrence to have the men complain that the motors they were using did not have sufficient power. However, since the installation of this rack, more care has been taken by the workmen to see that each motor is properly used.

Testing main reservoirs on the C. R. R. of N. J.

THE rack shown in the two illustrations is located outside of the locomotive shop building of the Elizabethport, N. J., shops of the Central Railroad of New Jersey. Each main reservoir to be tested is marked



Top: view showing the complete rack ready for operation—
Bottom: reservoirs undergoing test are placed onto four rollers so that they can be easily rotated

with the number of the locomotive from which it was removed and is placed on one end of the rack. Reservoirs about to undergo test are shown on the rack in the right foreground of the top illustration. Tested reservoirs marked OK for service are rolled to the opposite end of the rack.

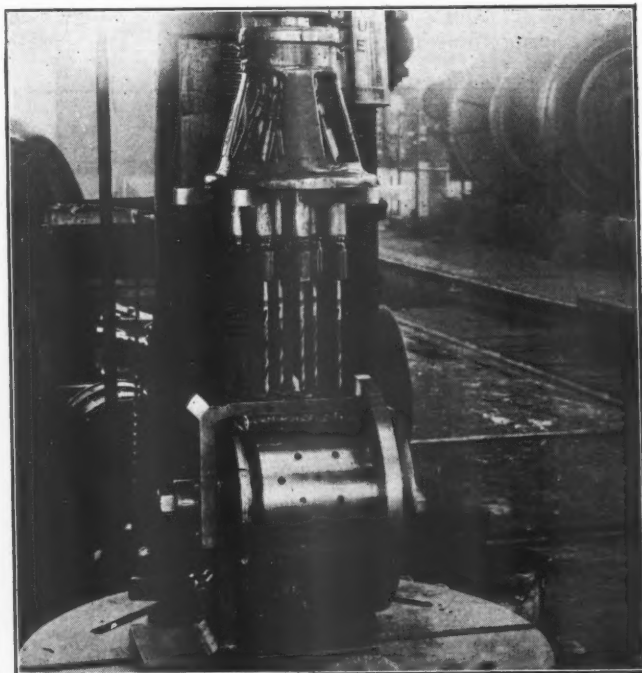
That portion of the rack on which the reservoirs are laid, consists of two rails. Each reservoir to be tested is rolled from the pile onto four rollers near the middle of the rails, as shown in the bottom view. It is then connected to a water pump, the connection to which is

fitted with Barco joints to permit free rolling of the reservoir.

After the connection to the pump has been completed and the pressure pumped up according to requirements, the inspector gives the reservoir a hammer test, after which it is rolled to the opposite end of the rack and marked with the test date. This method of testing reservoirs has resulted in a saving of 30 per cent of the time consumed by the old method.

Jig for drilling floating bushings

THE Bangor & Aroostook is numbered among the many roads that has applied floating bushings to locomotive side and main rods. A number of small holes are drilled around the circumference of these bushings for the purpose of feeding the grease to the pins. To drill these holes in a single spindle drilling machine re-

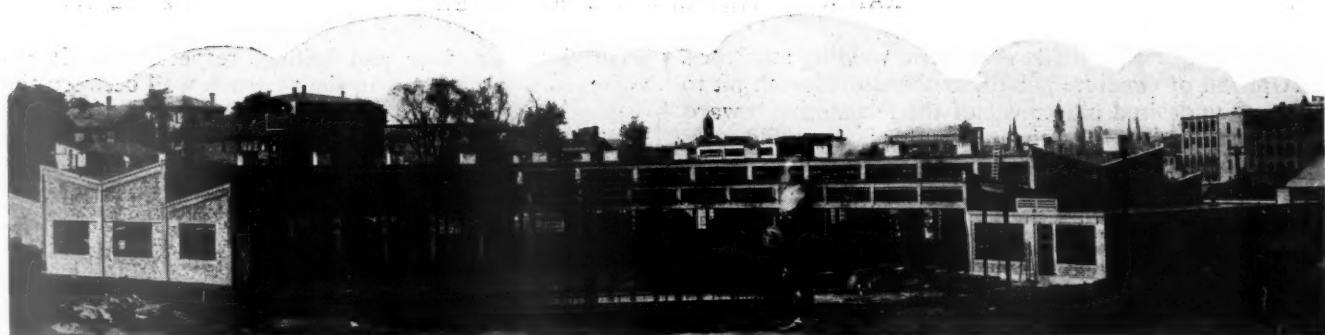


Using this jig, 60 holes may be drilled and countersunk in a floating bushing in from five to seven minutes

quires much time. The jig, shown in the illustration, was built in the Derby, Me., shops, for the purpose of reducing the drilling time to a minimum.

The jig consists of an ell-shaped base which is clamped to the drilling machine table. An angle-shaped piece, in which the drill-hole bushings are held by set screws, is bolted to the vertical arm of the base. The bushing is held in the jig between two centers, one of which has 12 notches cut in its circumference. The hand-operated latch on the left side of the jig, permits the operator to drill two staggered rows of holes.

The jig is adjustable for any size of bushing. Drill bushings have been provided for drilling $\frac{1}{4}$ -in. and $\frac{5}{16}$ -in. holes. A bushing may be drilled in from three to five minutes, depending on the size, and it requires about two minutes to countersink the holes. A six-spindle multiple drill head is used for this work.



The Boston & Albany new 15-stall enginehouse at Worcester, Mass.

Boston & Albany enginehouse at Worcester, Mass.

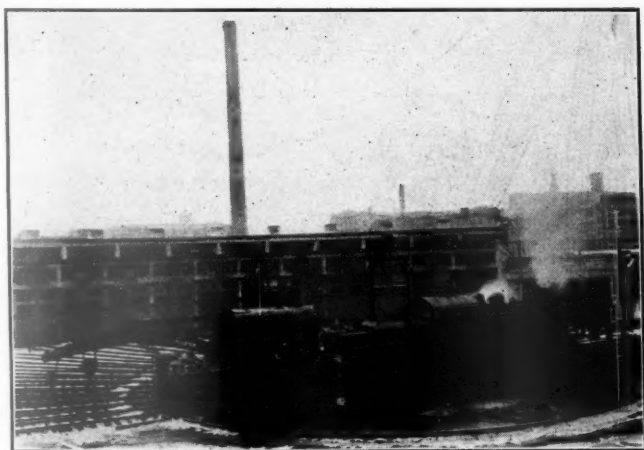
An annual saving of \$21,200 has been effected by modern buildings and equipment

THE placing in operation of the new 15-stall enginehouse at Worcester, Mass., by the Boston & Albany, has effected considerable economies by the elimination of a 48-year old enginehouse with inadequate shop facilities. The erection of a Fairbanks-Morse 200-ton coaling station has effected an annual saving of \$16,000; the installation of new cinder handling equipment an annual saving of \$1,200 and the realignment of the working force an annual saving of \$4,000, making a total annual saving of \$21,200. This saving partly justified the expenditure of approximately \$600,000 for the new buildings, equipment and relocation of the terminal tracks.

The enginehouse is located at the south end of the yard tracks and has 15 stalls, each having a length of 112 ft. In addition, six tracks are provided outside the building leading from the turntable, which have a storage capacity of about nine locomotives. The enginehouse is of reinforced concrete construction and has an

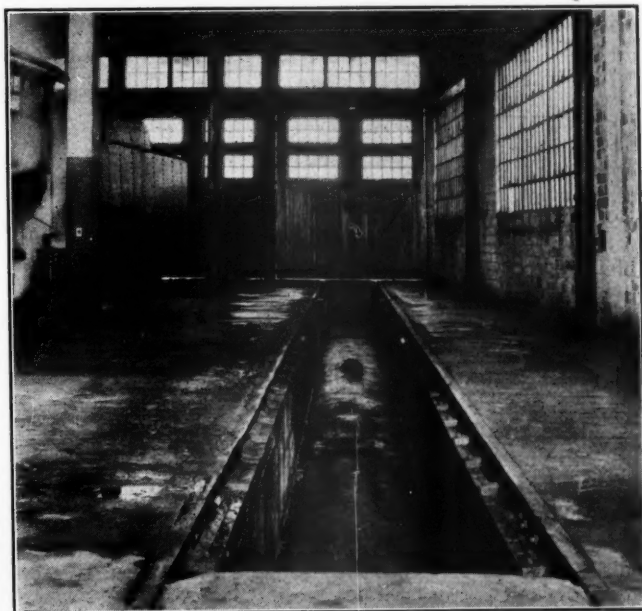
has been successfully overcome by first putting in concrete roof slabs, 5 in. thick, on top of which has been laid a layer of cork, 2 in. thick. This is covered with five layers of tar paper.

The roof is a modified form of the Monitor type, designed to provide maximum natural lighting at each pit. The effectiveness of the location of the windows can be



The 90-ft., three-point bearing, two-motor turntable

unusual roof design. Experience with concrete roofs has shown that the concrete sweats, which not only makes it uncomfortable for the workmen on the floor, but eventually causes the roof to crack. The trouble



One of the pits, looking toward the inner circle

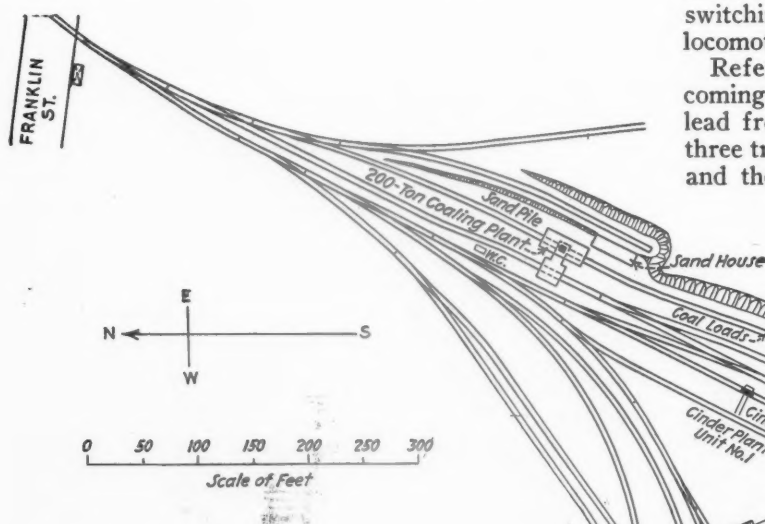
seen from the illustration showing the interior of the enginehouse. All of the windows can be regulated from the floor. Another interesting feature is the smoke jacks which are made of steel plates. Openings have been provided along each side of each jack to allow smoke outside the jack to pass through the roof. This feature is particularly desirable when a locomotive is not properly spotted underneath a jack. Two 200-watt adjustable flood lights for each stall are fastened to the enginehouse wall. Beneath each light is an out-

let for extension pit lights or electric welding machines.

A pitfall of concrete is built at the end of each pit to stop any undesired movement of the locomotive toward the outside wall. It is covered with planks sufficiently light to permit the wheels to break through, thus stopping the locomotive. In addition, the wall of the enginehouse in front of each pit is built separate from the rest of the wall. This is to provide a minimum of damage in case a locomotive should go through the wall.

The building is heated by the Sturtevant hot air heating system. The capacity of the system provides for six complete changes of air per hour. The inside temperature of the enginehouse can be readily raised to 70 deg. F., sufficient to thaw snow and ice from the frames and running gear when the outside temperature is below zero.

As shown in one of the illustrations, a small cast iron work bench, to which is attached a vise, is fastened to one of the columns between each two pits. This column



also has an electric outlet for extension cords. In addition to these benches and vises, a portable work bench and vise is provided for use anywhere in the enginehouse. Each mechanic is provided with an all-welded portable tool box on which is painted his name. These boxes are kept in an orderly row along the wall. The use of these boxes has made it possible to reduce the size of the tool room required and eliminates considerable time going for tools. The column at the head of each pit is provided with steam and air drop pipes. A 3-in. water pipe is located between alternate pairs of stalls. A 50-ton Whiting drop pit table serves two pits. The Nathan boiler tester and filler is used for washout purposes and hydrostatic tests.

A reinforced concrete, two-story office building has been erected at the north end of the enginehouse. The first floor includes the general foreman's office, the dispatcher's office, a wash room, toilet facilities and locker room for the enginehouse forces, and also the oil house, which is equipped with the Bowser system of oil distribution. The second floor contains a wash room, locker room, rest room and sleeping room with six single cots for the engine crews.

A feature of the engine crews' register room, located on the first floor of this building, is the revolving crew board. This board is mounted on two pivot bearings

secured to the floor and ceiling, respectively. It revolves in a window cut in the partition wall between the dispatcher's office and the register room. The board is laid out in the usual manner, spaces being provided for regular and extra crews, etc. It can be revolved from either side of the partition, which facilitates marking up the board on the part of the engine dispatcher's clerk, and it can be readily turned by any one in the register room to see that part of the board with which he is concerned.

Operation of the engine terminal

An average of 34 locomotives are dispatched each day from the Worcester engine terminal for passenger and freight trains over the main line east to Boston, Mass. and west to Springfield. Power is supplied for through freight service to Selkirk, N. Y. A total of 1,065 locomotives were dispatched during the month of December, 1927. These dispatchments were divided as follows: Passenger, 447; freight, 270; and switching, 348. This point is the home terminal for 32 locomotives.

Referring to the drawing of the terminal layout, incoming locomotives enter the layout on the single track lead from the passenger station. This track leads into three tracks, two of which pass under the coaling station and the third runs around it directly to the ash pits.

Plan of the Boston & Albany engine terminal at Worcester, Mass.

Each engineman makes his usual inspection at this point and turns in his work report at the general foreman's office. All tools are removed from the locomotive, inspected, placed in condition for service, tagged and placed in a tool room provided for that purpose. Each engineman is supplied with a tool box on which is painted his name and address. This work of storing, removing and replacing tools, is in charge of one man who also fills the grease cups and lubricators.

On completion of the engineman's inspection, the lo-

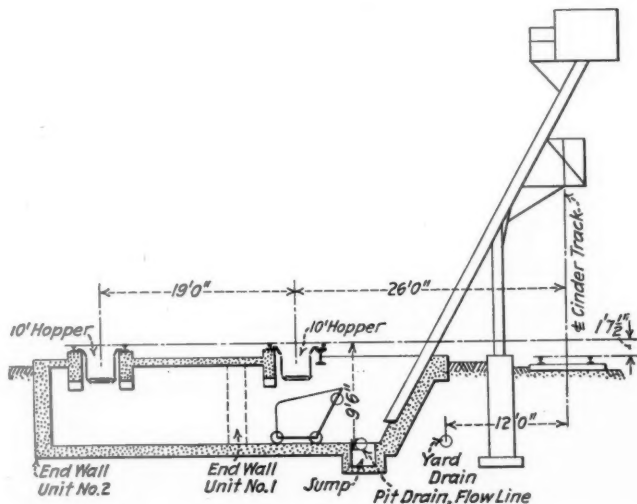
comotive is taken by a hostler to the coaling station which is located at the north end of the layout. At this point the sand box is replenished and the tender filled with coal. A small fireproof building, located to the south-east of the coal pocket, houses the Beamer steam sand dryer. Steam pressure of about 130 lb. is piped to

to stop the car at any position on the incline. An average of one and one-half cars are filled with cinders in 24 hours.

Inspection is made in the enginehouse

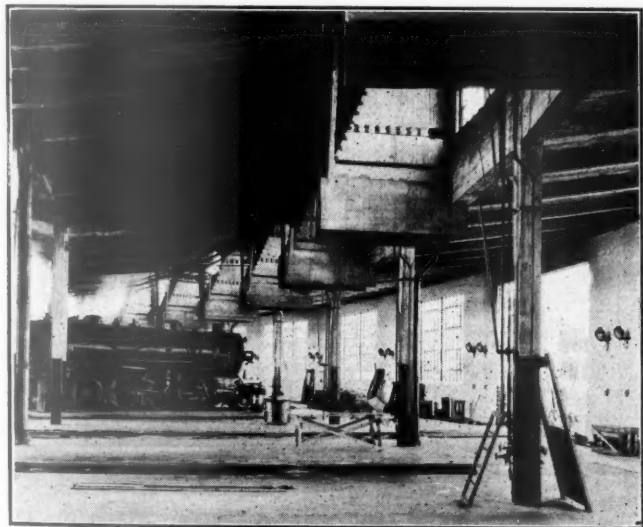
After the fires are cleaned, the locomotives are taken directly to the enginehouse via the 90-ft., three-point bearing turntable, which has a motor at each end. Here the inspector and enginehouse foremen give the locomotive a careful inspection, noting all defects on the locomotive inspection report. The enginemen's work reports which have been made against the locomotive during the past 30 days, are carefully examined to determine what work has been reported but not performed. The enginehouse foreman then determines the work to be done at that time.

Running repairs are made at this terminal. An average of 35 boiler washes are made every 30 days and in



A cross-section of the two-track cinder handling equipment

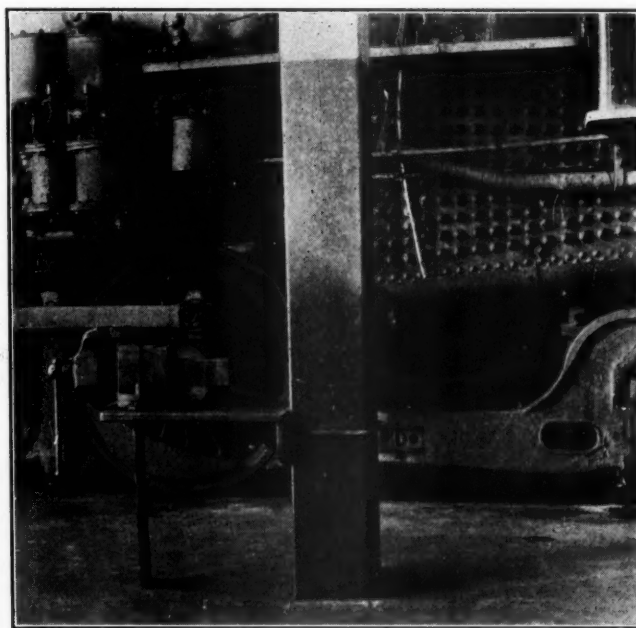
the sand dryer from the power plant. Sufficient sand is dried in eight hours to supply the terminal for 24 hours. Approximately 1,000 cu. yd. of sand are consumed in 12 months. Storage space has been provided for 8 cu. yd. of sand. The sand is supplied from a hopper built into the coaling plant. The coaling station is of the



The enginehouse interior is well lighted

mechanical type with a capacity of 200 tons, serving two tracks. About 180 tons of coal are handled in 24 hours.

Two electrically operated ash pits, one serving two tracks and the other, one track, receive the ashes from the locomotives. The pits are of the dry type. The ash pit tracks, shown in the drawing, are located over a concrete pit, 8 ft. deep, in which is a narrow-gage track on which operate the dump cars. The loaded dump cars are pulled up an inclined trestle which extends over the cinder car track. At a predetermined point, the dump cars are automatically tripped, dumping their contents into the cinder car. The movement of the dump cars is push-button controlled, which makes it possible



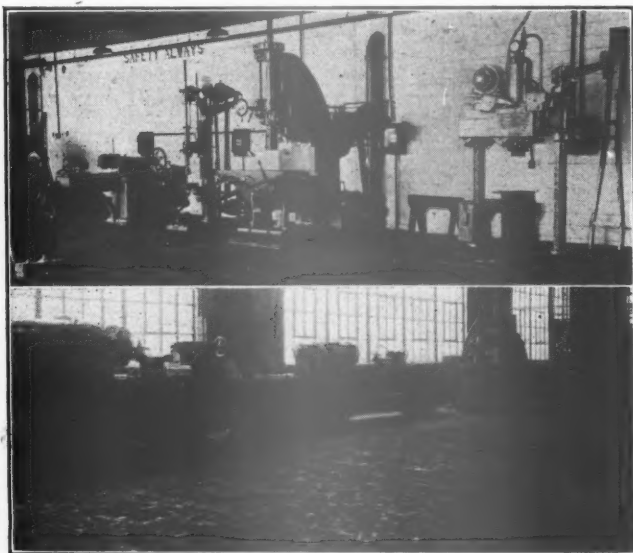
Iron vise benches are located between the pits

addition to work of this nature, the enginehouse forces also do considerable welding and boiler patch work. This work is done with 44 men on the first trick and 18 men on each of the second and third tricks, or a total force of 80 men. The enginehouse is well equipped with both gas and electric welding facilities to make repairs to the running gear, frames, boiler or tender. A portable electric welder is included in the equipment and service outlets for this welder have been placed at each stall. In addition to the two drop pit tracks, one of the pits is provided with a depressed rail on which are placed locomotives requiring spring repairs or renewals. In place of chain hoists, a locomotive crane truck with a telescopic boom, which extends from 12 ft. to 16 ft. has been furnished for handling heavy parts on and off the locomotives.

The machine shop

The machine shop is located at the north end of the enginehouse. It houses the tool room and the machinery for the heating system. This shop is equipped with all the machine tools necessary to handle running repairs, with particular attention paid to rod work. The following is a list of the machine tool and shop equipment:

No.	Type	Capacity	Builder
1	Crank planer	24 in. by 24 in. by 26 in.	Cincinnati Shaper Co.
1	Engine lathe	36 in.	Bradford Machine Tool Co.
1	Engine lathe	18 in.	Monarch Machine Tool Co.
1	Vertical drill	24 in.	Niles-Bement-Pond Co.
1	Vertical drill	No. 425	Colburn Machine Tool Co.
1	Tool grinder	10 in. by 1½ in.	Cleveland Armature Works
1	Pipe threader	4 in.	Oster Manufacturing Co.
1	Singlehead bolt threader	2 in.	Putnam Machine Co.
1	Combination punch & shear	Punch 1-1/16 in. hole in ¾ in. stock Shear ¾ in. plate	Buffalo Forge Co.
1	Bushing press	25 ton	Chambersburg-Engineering Co.
1	Portable electric welder	200 amp.	U. S. Heat & Light Corp.
1	Locomotive crane truck	3,000 lb.	Automatic Transportation Co.



The machine shop is equipped with modern motor-driven tools

Each machine tool rests on a concrete foundation which is set in the creosoted wood block floor. As the machine shop illustration shows, ample room has been provided around each machine to eliminate interference and allow for the piling of work. Each unit is motor-driven and controlled by push buttons.

The power house

The power house is a two-story brick and steel struc-



A corner of the blacksmith shop

ture with a radial brick stack, 150 ft. high and is located at the rear of the enginehouse, as shown in the plan drawing. Coal is received in carloads and dumped

into hoppers, then it is elevated into steel coal bunkers of 50 tons capacity. From these bunkers it is fed into the boilers.

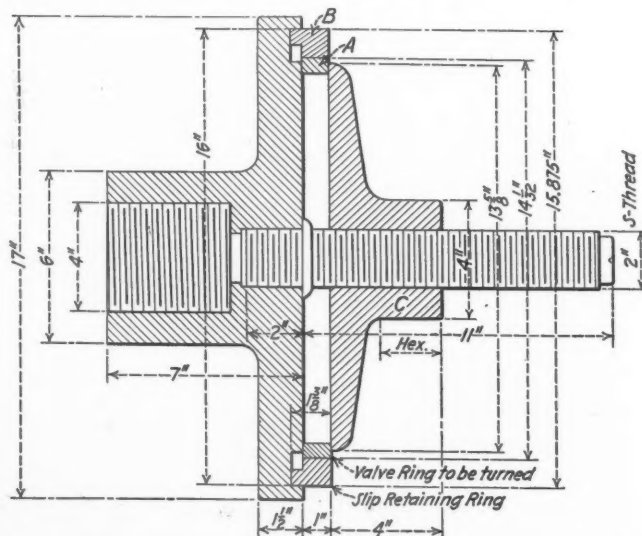
The boiler room contains two Heine cross-drum vertical-tube boilers of 300 hp. each. They are fitted with high and low water alarms, automatic dampers, stokers and with a forced draft blower driven by a Terry turbine. The boilers operate at a 135 lb. pressure. The feed water is heated by a Reilly feedwater heater, measured and supplied to the boilers by two Warren boiler feed pumps. The ashes are removed by a vacuum type steam ash blower.

The engine room contains an Ingersoll-Rand duplex steam and air compressor, which has a capacity of 823 cu. ft. of free air per minute. The steam from the compressor passes into the boiler feedwater heater, which brings the temperature of the feed water up to 120 deg. F. The compressor is provided with an after-cooler which removes the moisture from the air, thus protecting the pneumatic tools from corrosion.

Chuck for holding valve rings

By S. Showell

THE valve ring chuck, shown in the drawing, was designed to hold cut valve rings when truing up the outside surface to conform to the true surface of the valve bushing. It eliminates the usual practice of fitting rings to the bushings by hand. The following is the pro-



The retaining ring B centers the valve ring A on the face plate—the clamp C is tightened and the retaining ring is removed

cedure for finishing valve rings on the outside when using this chuck.

The valve ring for a 14-in. valve bushing with an outside diameter of 14 1/16 in., is cut to fit into the retaining ring B. It is then clamped to the surface plate by tightening the hex nut C. After the nut C has been tightened, the retaining ring B is slipped off the valve ring so that the surface can be trued up. Most shops generally carry three sizes of these rings in stock; namely, 14 1/16 in., 14 1/8 in., and 14 3/16 in. The chuck is provided with three retaining rings which are bored to 14 1/32 in., 14 1/16 in. and 14 3/32 in., which are used with the respective sizes of valve rings.

The Reader's Page

Have You a Question? Ask it.
Have You an Opinion? Express it.

A question on the locomotive inspection rules

KANSAS CITY, KAN.

TO THE EDITOR:

The following question came up on the road with which I am associated, but after considerable discussion no satisfactory answer was arrived at. Perhaps some of the readers of the *Railway Mechanical Engineer* can throw some light on the subject.

If I take a locomotive out of service on the twenty-second day of February, and put it back in service on the twenty-second day of March, have I the right to claim one month's extension of time for the locomotive, since the time out of service is not all in the same calendar month?

J. H. ALEXANDER.

What can be done about draft gears?

NEW YORK, N. Y.

TO THE EDITOR:

I have been keenly interested in the discussion about draft gears that has been going on in the editorial columns of the *Railway Mechanical Engineer* since last November. Frankly, I can not agree with all of the suggestions for improving draft gear maintenance that have been published since that time.

What is systematic draft gear maintenance? I know of several roads that have devoted a large amount of attention to trying to get that elusive thing called "system" into their draft gear maintenance and have never quite succeeded in accomplishing it.

Inspecting draft gears as you do air brakes, means a lot of work for the car man. There is only one way to inspect a draft gear properly and that is to drop it. Dropping a draft gear means burning off the rivets and then applying new ones. This means a lot of work and once you mention work, you automatically bring the human equation into the problem. All car department officers know full well the kind of inspection that air brakes frequently get and the grief they have in getting that work done properly. I wonder how many of your readers honestly believe that systematic inspection of draft gears is going to help materially in the solution of the problem?

Another point: Some draft gear manufacturers favor simultaneous closing of the gear with the contact of the coupler horn against the striking plate, although the A.R.A. recommends $\frac{1}{4}$ -in. clearance. Why can't the draft gear take the load? I know of one road which is making a serious attempt to secure "systematic" draft gear maintenance and one of the things it is doing is to keep a record of all coupler breakages.

One thing this record shows is that the largest single group of coupler failures is through the shank immediately back of the horn of the coupler. This is caused by the horn hitting the striking plate. It is evident that the $\frac{1}{4}$ -in. clearance between the horn of the coupler and the striking plate when the gear is in closed position is not sufficient to allow for wear of the gear. Why not make the recommended travel $2\frac{1}{2}$ in. instead of $2\frac{3}{4}$ in., which is present recommended practice, and increase the clearance to $\frac{1}{2}$ in. This would help considerably in reducing the number of broken couplers and worn or cracked striking plates and end sills. The draft gear is supposed to be designed to take the load, so why not place the load where it belongs.

I am heartily in accord with any effort to obtain better draft gear maintenance, but I do not see where much in the way of systematic maintenance can be accomplished until a lot more is done toward improving the design and the installation of the gear itself.

A READER.

Should the apprentice "think in formulas"?

DECATUR, ILL.

TO THE EDITOR:

I have read with interest the letter of D. C. Buell of the Railway Educational Bureau, published in the March issue of the *Railway Mechanical Engineer*, in which he criticizes some views of the writer on mechanical drawing and apprentice training which appeared in the January issue. I find that Mr. Buell and myself are in agreement on many of the fundamental premises, the only point of possible disagreement is that he seems to find it astonishing that the relative value of mechanical drawing in apprentice training courses needs any discussion whatsoever.

On a Class I railway of the middle west where apprentice training is voluntary with the apprentices themselves—their school work is received in night schools conducted by employees and officers of the railway—some young men who were graduated or about to graduate from their various apprenticeships expressed a preference for work in the drafting room and were given positions as tracers. It was significant that each one of these young men was so much of a draftsman that he fitted very acceptably into the drafting room staff. The only discouraging feature was the fact that they all seemed to have almost no knowledge at all of any relationship between mechanical drawing and shop work, and the further fact that they seemed to know and care very little about their various trades.

In fairness to their instructors and to their foremen, it may be said that these boys had never been in a receptive attitude toward their trades and had consciously

set out for careers as draftsmen. However, inquiries among the various apprentices of that shop disclosed that this condition was more general than one would suppose and that nearly all of these boys were too anxious to produce well executed drawings as a tangible proof of their progress, rather than to show a mastery of their craft.

Not long ago the writer received the following inquiry from an apprentice acquaintance and two or three chums who were about as far advanced in their apprentice work as he was: "Will you please give us the formula for finding the height of spring saddles?"

The writer worked out a problem but did not give a formula. Later on, the young man visited the writer and was asked if the answer given about spring saddle dimensions was satisfactory. The apprentice answered that the description given was understood but that they "wanted a formula." So, the writer, with the aid of a driving box, spring saddle and frame, wrote a formula.

He finally asked the apprentice if he was not thinking in formulas. The young man admitted that this was the fact and said that he supposed it was desirable enough and quite a general practice among the young mechanics to attempt to apply formulas to nearly every phase of their work.

Such occurrences have been common in my observations of our whole educational program. I am not attaching all the blame to instructors, or to methods, or to instruction courses. But these and similar incidents have led me to the belief that there is an over emphasis placed upon parts of the school work and particularly on mechanical drawing in many apprentice training schools, and I believe that the subject is worthy of discussion.

WARREN ICHLER.

What's the answer to this?

SOMEWHERE ALONG THE LINE

TO THE EDITOR:

The following conversation was recently overheard and made note of by one of our supervisors and he submitted it for consideration and discussion at our foremen's meeting:

"Well! I see Joe Stack got let out of the spring department today. I heard he was off for a few days on account of his wife being sick and when he came in, found his job was filled by some one else. Pretty rotten, I'll say!"

"Oh, I don't know so much about that. You know he was only taken on a few weeks ago and was told at the time the job he was assigned to required regular attendance; also that he was getting it on account of the Welfare Committee asking that he be given something to do on account of being hard up and out of work so long. This was also the third time he was off since starting in."

"He sent word in, didn't he, that he couldn't get to work on account of his wife's illness?"

"Yes, he phoned in about 10.00 o'clock, but what use was that? One man being off out of that department, as you know, upsets the whole output for the day. The place cannot be successfully operated on sympathy. I know Mr. Bell, foreman of that department, would never do anyone dirt, but he has to look after his own interests, as well as his men's, and Joe should have got a woman to stay with his wife if he wanted to hold his job. I happen to know Mr. Bell

tried to borrow a man from your department temporarily, but you told him you had none to spare and if you did have, none of them would care to do that job and you didn't intend to disrupt your gang that way. So I think you are partly to blame yourself for Joe getting let out."

"Oh! Is that so? Well, Mr. Bell should have insisted that some of the other foremen send a man out there while Joe was off and kept the job open for him, even if he went to the superintendent about it."

"Well, it's a hard thing to do, I know, but I don't blame Mr. Bell at all. He is not responsible for home conditions and why make Joe's hard luck, his trouble as well. It's one of those cases where your head has to rule and not your heart. You can't run on a production basis and at the same time operate a Welfare League, while men can be hired who will be present every day. I think Mr. Bell was justified in letting him go. Joe was not an old employee, in which case some consideration might have been shown."

"I can't see what difference length of service should make. Some one or some agency must now take care of Joe's case and I think it was up to Mr. Bell to do his part."

What do you readers think?

OBSERVER.

Testing air brakes

SOLDIER SUMMIT, UTAH

TO THE EDITOR:

The March, 1928, issue of the *Railway Mechanical Engineer* contains a question by W. A. Burnham relative to testing air brakes. According to my understanding of his question, his trouble is caused by a very dirty and sluggish feed valve. The applying and releasing of the brakes is due to the opening and closing of the feed valve which causes a variation in train line pressure.

FRANK ROBINSON

A suggestion for identifying freight car brake levers

FRANKLIN, PA.

TO THE EDITOR:

When I read, on page 242 in the April issue of the *Railway Mechanical Engineer*, the item entitled "Wrong brake levers cause cast-iron wheel failures," it recalled to my mind the trouble we had back in 1900, with wrong brake levers when I was superintendent of motive power of the Pere Marquette.

To identify the proper brake levers for a freight car, why not stencil the truck levers on the side of the truck bolsters, and the cylinder and floating levers on the body sills? A full size lever could be shown with the brake pin holes and spacing or, say, 1-in. dots, representing the pin holes with the distances between them shown. Where fabricated truck bolsters are used, the stencilling could be placed on the body sills directly over the truck A.R.A. Committee on Brakes and Brake Equipment and levers. By this method, a car repairman could tell at a glance what dimension lever was required in case of replacement.

I offer this suggestion for the consideration of the others interested.

B. HASKELL.



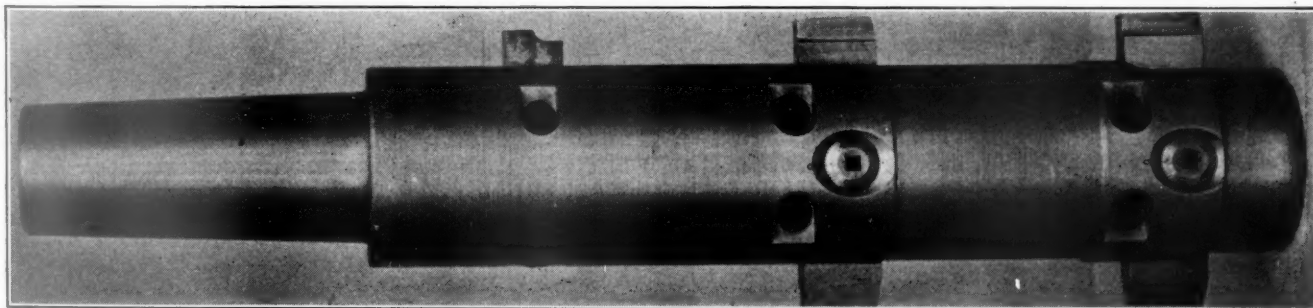
Expansion boring bars of simplified design

SIMPLICITY of design and ease of adjustment are features of expansion boring bars recently placed on the market by the Larkin Packer Company, St. Louis, Mo. These bars are offered as production tools designed to maintain accuracy of bore and to compensate for wear on the cutters by a micrometer adjustment. There are only four main parts: an adjusting screw, with .001-in. graduations; a wedge threaded on the adjusting screw which serves to expand the cutters; a thrust collar for piloting the adjusting screw, and a removable bushing for retaining the expansion units in the body.

The method of expanding the cutters provides for accuracy and rigid construction. Wedge action, with

A hardened and ground eccentric locking screw, with threads at both ends serving as pilots, employs a positive cam movement for clamping each cutter in its slip-fitted slot. The cutters are immovable until the locking screw is released. To facilitate removal of the cutters, the head of the locking screw has an indicator mark set at zero, located on the point where the cam pressure on the cutter is released. Each cutter is held independently. Right and left hand threads throw the locking movement inwardly against the wedge.

The body of the boring bar is of forged chrome-nickel steel and is heat treated. Cutters are of high speed steel and are heat treated and tested to assure uniformity of hardness. When worn undersize, be-



Larkin expansion triple-duty car wheel boring bar

bearing above and below the center on the angles of the cutters, forces the cutters uniformly outward as the micrometer screw is turned. The hardened wedge, which is prevented from rotating by keyways, is threaded on the adjusting screw and travels forward or backward as the screw is turned. This adjusting screw rotates but does not travel. Thrust at the bottom is taken by a hardened and ground thrust collar, which serves as a centering unit for the conical point of the adjusting screw, and also to support the adjusting screw on dead center. The wedge is arranged to support the thrust of the cutters and eliminate side play under strain.

The expansion unit is accurately fitted in place from the front of the bar and retained with a removable bushing, which provides access to the adjusting parts for purpose of replacement without damaging the bar.

yond range of expansion in one bar, the cutters can be used in smaller diameter bars of the same slot dimensions.

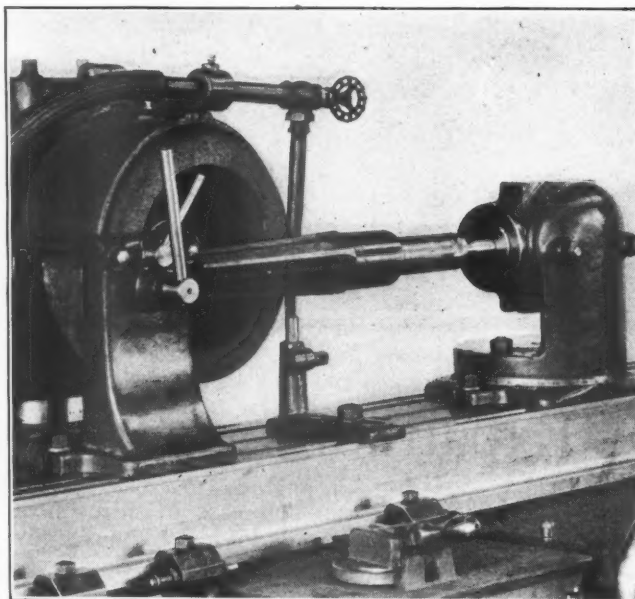
Ten stock styles and 16 stock sizes of the tool for various boring operations, are available. Bars for boring car wheels, locomotive driving boxes, driving rods, rod brasses, rocker boxes and brasses, etc., can also be furnished, as well as bars for special requirements.

ALLOY STEEL CASTINGS.—The Birdsboro Steel Foundry & Machine Company, Birdsboro, Pa., has issued a pictorial folder, titled "Birdsboro-26," illustrating industrial uses of its new high strength cast steel, together with interesting test figures. This bulletin is of special interest to steel plant, railroad and other executives who wish to acquaint themselves with a steel of greater physical properties.

Thompson cutter and reamer holder

THE Thompson Grinder Company, Springfield, Ohio, has recently developed a new cutter and reamer holder for use with the Thompson 12-in. by 36-in. universal grinding machine which is now included with all universal equipments for that size machine. The development of this new tool equipment was actuated to meet the demands for an attachment to handle the various reamers and cutters used in the average railroad shop.

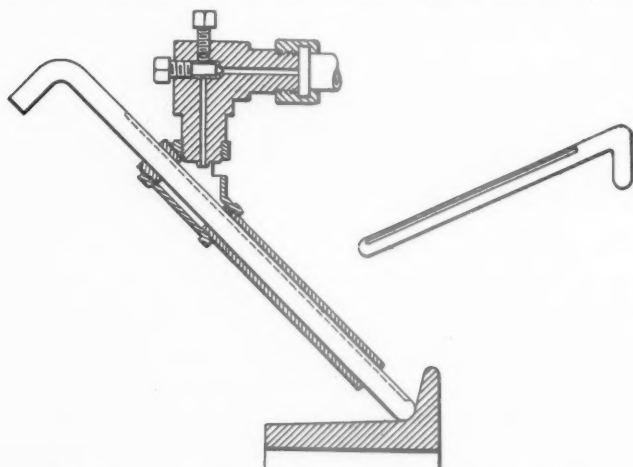
This cutter holder has a capacity for milling cutters up to 12 in. diameter, either straight or spiral, and can be swiveled either through a vertical or horizontal plane. The holder is used with a cup wheel so that straight angle clearance may be obtained on the cutter teeth. A tail stock is used when reamers are to be ground on centers. It has a capacity for reamers from $\frac{1}{2}$ in. to 12 in. diam. and 36 in. long. The tail stock is so designed as to permit the free passage of the cup wheel without interference on the small reamers. It has a sliding quick action movement to the center and a quick action clamp for locking it in position. The headstock is fitted with the new standard taper hole recently adopted by the milling machine manufacturers and can be bushed down to any size taper or straight hole with collets to fit the various shanks on reamers or arbors.



Both headstock and tailstock are used for reamers ground on centers; the headstock only is used for milling cutters

A gravity feed tire flange oiler

TWO Mikado type locomotives owned by the Winston-Salem Southbound have been equipped with gravity feed flange oilers patented by J. C. Burford, mechanical supervisor, located at Winston-Salem, N. C. The device consists of three parts, the oil reser-



The plunger of the gravity feed flange oiler may be quickly replaced

voir, the needle for regulating the flow of oil and the plunger which feeds the oil to the tire flange.

The oil reservoir is located on the running board. A pipe leads from the reservoir to the regulating valve which contains an adjustable needle valve which, after being set, is held in position by a set screw. The oil flows down to a plunger made of ordinary iron $\frac{1}{2}$ in. in diameter, in which is milled a small groove into which the oil flows down to the flange. After the adjusting

has been properly set it need not be disturbed as a cut-off valve is located between the supply tank and the valve. The engineman opens this valve at the beginning of his run and closes it again at the end of the run.

The oiler is placed just above the horizontal center line of the wheel a little forward or back of the wheel at an angle of about 15 deg. to the wheel tread. Close observations have shown that the plunger follows the flange contour regardless of track irregularities, thereby allowing no excess oil to spread over the tread which would cause the wheels to slip. It is stated that the cost for oil averages about 20 cents per 1,000 engine mile.

Large wheel truck for oxy-acetylene equipment

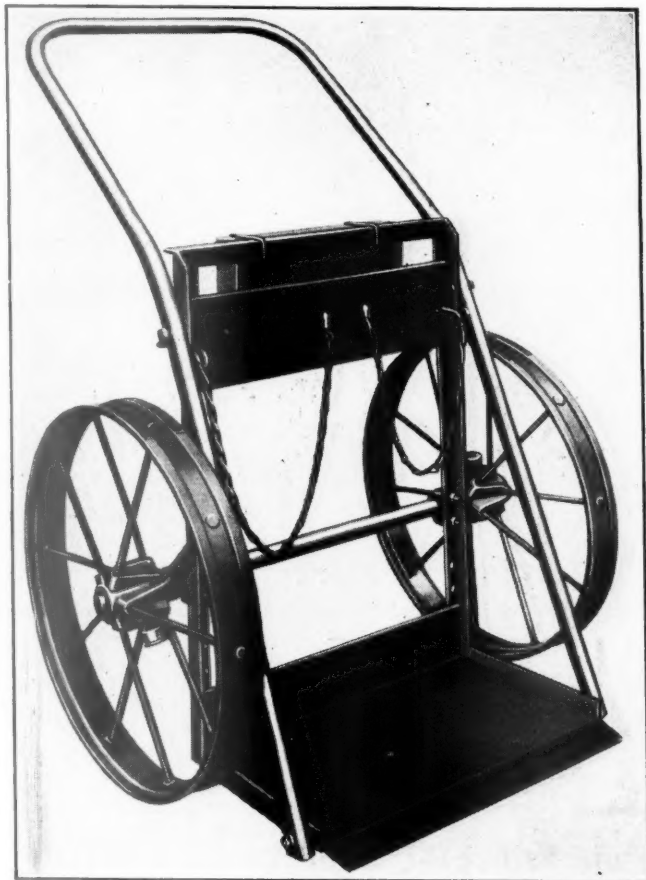
THE Oxweld Acetylene Company, 30 East Forty-second street, New York, has placed on the market a two-wheel truck, the feature of which is the increase in the wheel size in order to make the truck easier to handle.

The illustration shows the truck equipped with 24-in. steel wheels, having 3-in. by $\frac{3}{8}$ -in. grooved tires and a cast iron hub. The hub is bored to fit the cold-rolled steel axle, and a grease cup is provided. Lubrication is of particular importance in overland pipe line work where the truck may be hauled long distances at a fairly high speed behind a motor truck.

The handle is continuous and the upper portion is bent back about 8 in. so that the truck can be easily handled by an operator of small stature. The tool box is larger and is provided with a cover and a holder for extra blowpipe tips.

Where 24-in. wheels are not required, 14-in. wheels may be used instead, merely by changing the position of the axle to the lower set of holes which are already

versible. The bar cutter is the same as on other U. D. machines. Angles can be cut on a miter without in-



Oxy-acetylene truck with 24 in. wheels

drilled in the frame. The same frame and axle can be used with either size wheels. No grease cups are necessary with the smaller wheels used on these oxy-acetylene trucks.

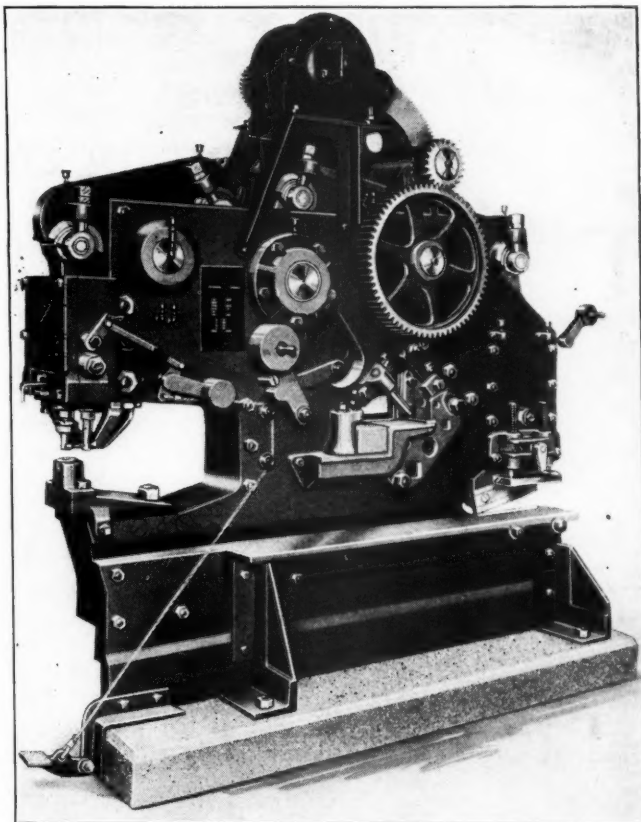
Two additional sizes of universal iron workers

THE Buffalo Forge Company, Buffalo, N. Y., has placed on the market two all-steel universal Nos. 2½ and 3½ combination punches, slitting shears and bar cutters to meet the need of shops requiring machines larger than Nos. 0, ½ and 1½ previously described in these pages, and yet do not require the high punch throats of the large No. 25 U. D. series.

One eccentric runs all three tools—the punch, shear and bar cutter—in succession, that is, all three tools are actuated during the course of one revolution of the eccentric but not at the same instant. This prevents overloading the machine and yet permits using the three separately controlled parts of the machine at the same time.

Interchangeable high and low die blocks on the punch end handle beams, channels, girders, Bethlehem beams and H-sections, although not in so great a range of sizes as the large U. D. machines. As the stripper swings out of the way when changing tools, retooling is simplified considerably.

The shear blades are exceptionally long and are re-

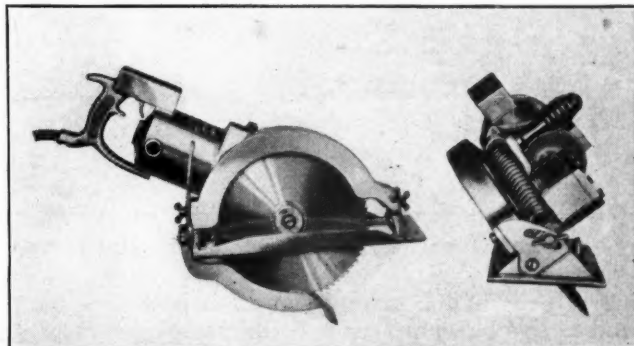


The Buffalo No. 2½ universal iron worker

clining the stock. A triple punching attachment can be furnished if desired.

Portable hand saw will cut at an angle

IN addition to vertical sawing, the Type B portable electric hand saw manufactured by the Wodack Electric Tool Corporation, 4629 West Huron street, Chicago, provides for bevel sawing at any angle up



Two views of the Type B Wodack portable electric hand saw

to 60 deg. This is accomplished by a tilting saw base which can be set and locked at any angle within this range by a slide and lock nut.

Another new feature of this saw is a width gage for vertical sawing, which can be set for any width

from 3 in. to 6 in. With this gage, various widths of strips can be sawed without the necessity of marking and with greater accuracy and uniformity.

The saw is equipped with a General Electric universal

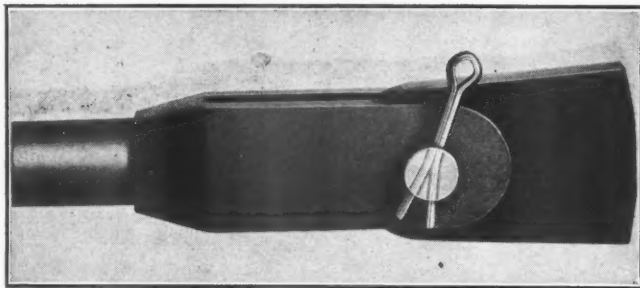
motor of special design which operates on both a.c. and d.c. current and is furnished for 110 volts, 220 volts or 250 volts. Each saw is furnished complete with one 11-in. and one 9-in blade ready for use.

Self-opening cotter key and pin

THE self-opening, self-retaining cotter key and pin which has recently been patented and placed on the market by the American Railway Products Company, Inc., 74 Washington Street, South Norwalk, Conn., is designed to eliminate the troubles often experienced in applying the conventional type of cotter pin. The principle of the design is the formation in the end of the cotter pin of a vee piece by drilling two outlets which converge into the single hole on the key entrance side of the pin. This opens the cotter key when driven home.

When the end of the cotter key makes contact with the vee piece in the pin, the cotter key is opened and follows the diverging cotters as it is driven home. The cotter key "digs in deep" wherever it is placed and holds tight. This design of cotter key and pin eliminates the necessity of using a chisel to open the key which often leads to a fracture causing it to break. The cotter key is easily applied in out of the way places. A snug fit is obtained when installed, thereby overcom-

ing rattle and vibration. It can be applied to present equipment or new equipment for all types of pins and cotters. Any standard cotter key can be used although

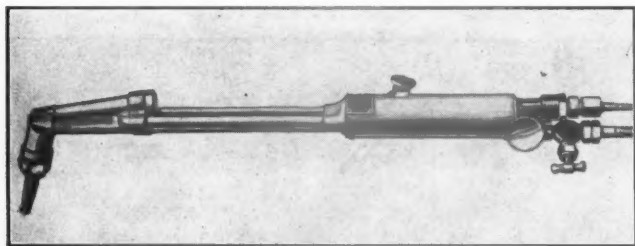


A self-opening, self-retaining pin and cotter key applied to a brake lever connection

the self-centering type in which the split ends of the key are tapered outward is recommended.

Oxygen blowpipe designed to prevent backfire

A CUTTING blowpipe, designated as Type C-14, which will not backfire even under the most severe operating conditions, has been added to the line of the Oxweld Acetylene Company, 30 East Forty-second street, New York. This blowpipe uses the same nozzles as the Oxweld Type C-2, which it resembles, although several improvements in design have been made. The three gas tubes are straight, having no bends either outside or inside the handle. The cut-



The Oxweld Type C-14 cutting blowpipe

ting valve is of the same design as is now used on all hand cutting blowpipes made by the same manufacturer.

Some time ago the small needle valve bodies used for acetylene on the cutting blowpipes, were improved by making them pressure forgings. In addition to these, both the head and the rear body of the Type C-14 are also pressure forgings, instead of castings, giving a much better appearance, increased durability and less weight.

Interchangeable nozzles are provided so that the

blowpipe may be used with either medium or low pressure acetylene. Obviously the medium pressure nozzle cannot be used with low pressure acetylene, but the low pressure nozzle can be used with a medium pressure acetylene supply if low pressure is maintained in the hose and blowpipe. To accomplish this, the regulator should be adjusted to give a flame showing an excess acetylene cone not more than one inch long when the acetylene valve on the blowpipe is wide open. The acetylene valve should then be adjusted to obtain the neutral flame.

Pneumatic ball bearing coach lifts

THE illustration shows two air operated ball bearing mechanical coach lifts, manufactured by the Joyce-Cridland Company, Dayton, Ohio, which can be operated, set in place and controlled by one man. These jacks are equipped with automatic stops on the up limit and also on the down limit. Should the air leak out, or should there be a complete air failure on the coach track, these jacks will hold their load in any position at any point in ascent or descent where this condition occurs.

The jacks are operative on from 60 lb. of air or higher. They will do their work on as low as 50 lb. of air, but the up movement is slower. A standard V-type Ingersoll-Rand motor is used which may be detached for repair and inspection without completely dismantling the unit. In emergency work the jacks

may be coupled to the train line and the locomotives supply the air to the motors. The jacks are equipped with the Alemite lubrication system.



Two Joyce-Cridland pneumatic jacks lifting a steel passenger coach

The jacks are now available for lifting freight cars and in 75-ton and 100-ton sizes for locomotive repair work and other heavy duty service.

An air operated horn for railway service

A WARNING signal device for use on rail motor cars and electric and steam locomotives, has recently been placed on the market by the Westing-



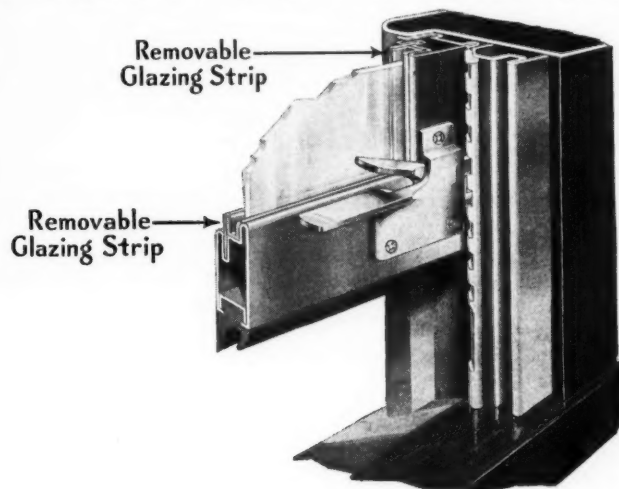
The Westinghouse pneumatic horn for use on rail motor cars and locomotives

house Air Brake Company, Wilmerding, Pa. This horn has a harmonious tone combination which is easily distinguished from other right of way noises. It uses little air, requires no special reducing valve, operates successfully over a wide range of pressures and is of sturdy and durable design.

The diaphragm or vibrating unit, enclosed in a cast base, is a substantial phosphor bronze disc uniquely balanced by a small weight. The bell of the horn is highly burnished, heavy gage instrument brass. The horn is available in various types and sizes to obtain different tonal qualities, and in combinations for producing a pleasing chime effect when desired. It is designated as the Pneumatic horn.

Removable glazing strips for coach windows

THE O. M. Edwards Company, Inc., Syracuse, N. Y., has recently completed the development of metal car window sash with removable glazing strips. When brass window sash first made its appearance some years ago, there was no provision for quickly reglazing



The Edwards removable glazing strips make it possible to replace a window pane with the sash in place

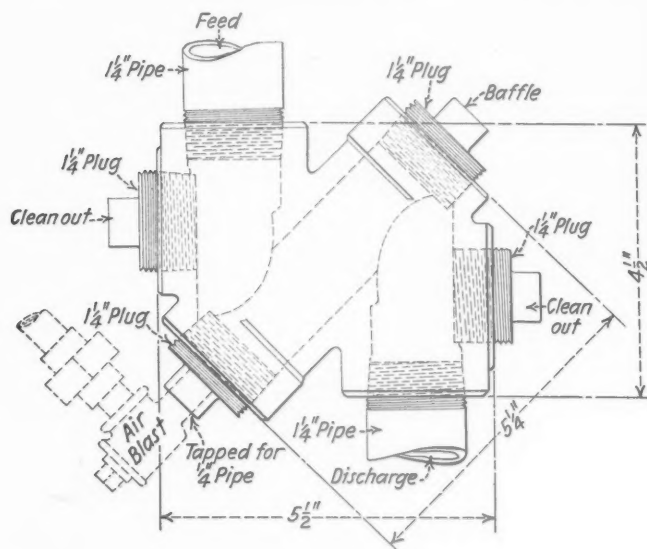
the sash in case of glass breakage. With this new feature a sash may be reglazed in as short a time as two and one-half minutes without removing it from the opening. Brass glazing strips are set in slots in the sash on the outside of the glass, which sets in a rubber strip of channel section. To replace the glass the brass strips are removed from the two side stiles and then from top rail, and the new glass placed in the opening. The strips are then reinstated in their grooves in the reverse order and the sash is ready for operation. No screws are used to hold the strips in place.

ELESCOOPERATION.—This is the title of an interesting 16-page brochure being distributed by the Superheater Company, 17 East 42nd street, New York, outlining the organization and engineering service of the company. It briefly describes the Elesco stationary power plant superheater and the progress in Elesco served power plants. A chart shows the expected or realized performance of these superheaters at the Hell Gate and East River stations of the United Electric Light & Power Company and the New York Edison Company, where steadily increasing capacities are demanded from single boiler units.

An interchangeable locomotive sand trap

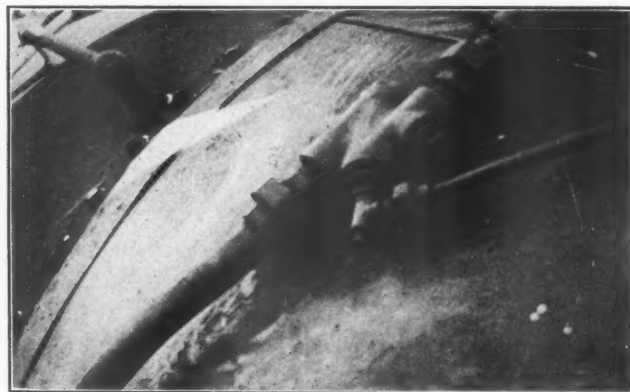
OWING to the cutting quality of sand under pressure, the walls of a sand trap quickly wear out. W. H. Buckingham, Lock Box 632, Mayfield, Pa., has patented and has had in service for a period of three years an interchangeable reversible sand

walls in the upper end of the diagonal passage are worn thin by the action of the sand. When this occurs the sand trap is turned end for end, thus causing the thick walls to receive the abrasive action of the sand. The sanders are also interchangeable in that



A drawing of the sand trap

trap for which it is claimed that the life is twice as long as others now in use. At each end of the diagonal passage through the sand trap is a 1 1/4-in. plug. When the sander is applied to the locomotive, the jet nozzle enters the trap through the lower plug. In time, the



The sand trap is reversible and can be used on either side of the locomotive

they can be used in any position on either side of the locomotive.

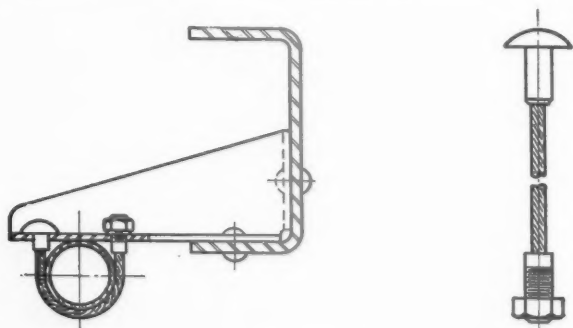
Bolts, gaskets, nuts, adjustable parts, etc., have been eliminated, thus leaving no complicated parts to get out of order. The removable plug at the bottom contains the air jet which makes it convenient when nozzle repairs are required. Two 1 1/4-in. plugs, one on each side of the sand trap, are used when it is necessary to clean out the trap. This feature eliminates removing the sand trap for cleaning.

A flexible bolt designed for many uses

THROUGH the development of the preformed type of wire rope which makes possible the attachment of fittings by the processing method that makes the fitting an integral part of the rope, the American Cable Company, 215 N. Michigan avenue, Chicago,

water piping, shackle bolts for temporary wall boxes, tanks, etc., for scaffolding and tackle on various parts of machinery and in other places where semi-flexible connections are necessary.

Preforming the wires and strands to the exact helical shape they must assume in the completed rope, results in a cable that does not require seizing but may be cut like a rod. This type of rope permits close fitting attachments to be slipped over the unseized ends of the rope and to be processed cold so that the steel of the fitting flows into the interstices of the rope and thus becomes practically an integral part of it. Such fittings can be threaded for a nut or capped for a head. The flexible bolt, which has resulted from these developments is available in varying lengths.



How the flexible bolt holds a pipe in position

has recently perfected the Tru-Lay-Tru-Loc flexible bolt, shown in the illustration.

These bolts may be used in many places in and around the shop or in any place where rigid U-bolts are impracticable. They can be used as auxiliary hangers for power shafts, suspension brackets for overhead steam or

ROLLER BEARINGS.—Two four-page bulletins descriptive of roller bearings in railroad service and nickel alloy steels for roller bearings have been issued by the International Nickel Company, 67 Wall street, New York. The former bulletin describes performance records of the Chicago, Milwaukee & St. Paul heavy limited trains equipped with roller bearings and details of improvements in operation with savings effected by their use. The latter bulletin describes the details of construction of nickel alloy steel roller bearings carrying heavy loads at high speeds. Tables show the physical properties required of the materials used to meet this severe service.

News of the Month

PROMOTIONS AND APPOINTMENTS THE SUPPLY TRADE
CLUB AND ASSOCIATION NEWS NEW TRADE PUBLICATIONS
NEW SHOPS

Convention of National Association of Foremen

The fifth annual convention of the National Association of Foremen will be held at Canton, Ohio, on Friday and Saturday, May 25 and 26. The program for this convention includes addresses by men of national importance in industrial affairs and visits to industrial plants in Canton and its immediate vicinity. The speakers and their subjects are as follows: F. A. Seiberling, president of the Seiberling Rubber Company and founder of the Goodyear Tire & Rubber Company—The requisites of the foreman of tomorrow; A. B. Segur—Conservatism of man power through motion analysis; W. Chattin Wetherill, University of Pennsylvania—Industrial waste; J. C. Wright, director of the Federal Board for Vocational Education—Foremen conferences, and Robert H. Spahr, U. S. Chamber of Commerce—The foreman as an executive.

B. & M. employees' fund

The Boston & Maine Railroad Employees' Fund has been incorporated with a board of five trustees, to receive and administer the fund of \$100,000 given by the directors of the road for the benefit of employees on the advice of Homer Loring, recent chairman of the Board of Directors, when he declined that sum for his recent special services.

The trustees are: Mr. Loring, President; George Hannauer; W. Rodman Peabody, member of the board of directors; Cameron MacKay a passenger conductor on the Portland division, and Joseph M. Sullivan passenger trainmaster, Terminal division. Mr. Loring was chosen chairman, and Arthur B. Nichols (Boston), treasurer and clerk.

The purposes of the corporation under which the fund is to be received and administered in trust, are stated as follows: "To advance the general welfare of the employees, in whatever capacity of service, of the Boston & Maine Railroad and of its subsidiaries, by disbursing the funds of this corporation to the benefit of such employees and their dependents for such educational, charitable, literary or scientific purposes, as authorized by Section 2, of Chapter 180, of the general laws of Massachusetts."

Mr. Loring, who insisted that this money which was voted him for his work in rehabilitating the Boston & Maine should be given by the railroad corporation instead to such a fund, consented to serve as a trustee only on a temporary basis. The specific application of the fund will be determined later.

Wrought iron manufacturers form association

Representatives of the leading manufacturers of wrought iron in various parts of the country met April 5, 1928 at Pittsburgh, Pa., and formed the Wrought Iron Research Association, the principal object of which is to gather and disseminate information about wrought iron.

The members of the Association are the American Swedo Iron Company, Philadelphia, Pa.; The Burden Iron Company, Troy, N. Y.; A. M. Byers Company, Pittsburgh, Pa.; Cohoes Rolling Mill Company, Cohoes, N. Y.; Ewald Iron Company, Louisville, Ky.; Glasgow Iron Company, Philadelphia, Pa.; Highland Iron and Steel Company, Chicago; Hughes & Patterson, Philadelphia, Pa.; Logan Iron & Steel Company, Philadelphia, Pa.; Lockhart Iron & Steel Company, Pittsburgh, Pa.; Penn Iron & Steel Company, and Pittsburgh Forge & Iron

Company, both of Pittsburgh, Pa.; Reading Iron Company, Reading, Pa., and Ulster Iron Works, Dover, N. J.

The executive committee consists of seven members with offices as follows: Geo. O. Boomer, vice-president, Ewald Iron Company, Louisville, Ky.; Frank W. Hamilton, president, Ulster Iron Works, Dover, N. J.; J. M. Gillespie, vice-president Lockhart Iron & Steel Company, Pittsburgh, Pa.; L. M. Johnston, vice-president, A. M. Byers Company, Pittsburgh, Pa.; Snowden Samuel, secretary, American Swedo Iron Company, Philadelphia, Pa.; L. E. Thomas, president, Reading Iron Company, Reading, Pa.; and William C. Wolfe, manager of sales, Highland Iron & Steel Company, Chicago. L. M. Johnston was elected president and Mr. Snowden Samuel, secretary-treasurer of the Association.

Headquarters of the association will be at Pittsburgh, Pa.

AREB Club studies miniature locomotives

READERS OF THE *Railway Mechanical Engineer* are familiar with the AREB Clubs, or American Railway Employed Boys' Clubs, which have been formed at many places in recent years and are giving such an excellent account of themselves. A visit of some of the members of the Chesapeake & Ohio Club of Huntington, W. Va., to the Baltimore & Ohio centenary celebration last fall, stimulated a desire on their part to build a miniature locomotive. The railway management granted the club permission to build such a locomotive and as a result the members of the club made a trip to the cities of Baltimore, Md., and Washington, D. C., to secure information and data for its construction. Two days were spent in Baltimore visiting some of the Baltimore & Ohio officials and J. H. Coventry, a mechanical engineer of Baltimore, who built several of the miniature locomotives for The Fair of the Iron Horse. Companies from which materials for such locomotives were purchased were also visited. Abundant information and working data was also secured from the Bureau of Railway Economics in Washington, special courtesies being extended through Miss Elizabeth Cullen, the reference librarian. The home of J. N. Swartzell was visited in order to examine his miniature railway shops and yards. Visits were also made to the state rooms at the White House and the Washington Navy Yard.

The president of the AREB Club at Huntington is O. R. Nicholas. The club has also undertaken another ambitious project in the attempt to launch an international AREB Club paper, C. W. Atkins functioning as its editor.

Meetings and Conventions

Spring meeting A. S. M. E.

The spring meeting of the American Society of Mechanical Engineers will be held at the William Penn Hotel, Pittsburgh, Pa., May 14 to 17, inclusive. On Monday morning, May 14, there will be a council meeting and a conference of local sections' delegates, followed in the afternoon by simultaneous sessions of the fuels and heat flow and management divisions. The seamless tubing, hydraulic and railroad divisions will meet on Tuesday morning, May 15. The papers to be presented at the railroad session are locomotive and freight car utilization, by C. B. Peck; power brakes and modern train operation, by L. K. Sillcox, and locomotive sparks, by L. W. Wallace. A train ride through the plants of the U. S. Steel Corporation has been arranged for Tuesday afternoon.

Following the student branch conference and the simultaneous sessions of the machine shop practice, applied mechanics, glass and engineering education divisions on Wednesday morning, there will be an inspection trip through the plant of the Westinghouse Electric & Manufacturing Company. At the dinner in the evening the Holley medal will be awarded to Elmer A. Sperry. On Thursday, May 17, there will be a joint meeting of the materials handling and management divisions, also meetings of the central station power, alloys and applied mechanics divisions. At the applied mechanics meeting F. Loewenberg will present a paper on stresses in the drive system of three-cylinder locomotives. The inspection trip Thursday afternoon will be to the American Window Glass Company, Jeanette, Pa.

Railway Fuel Convention

The formal program of the twentieth annual convention of the International Railway Fuel Association has just been released and from all present indications the three-day meeting, to be held May 8 to 11 inclusive at the Hotel Sherman, Chicago, will be even more successful than usual. An examination of the list of individual papers and committee reports to be presented shows a well-balanced and instructive program which will be broad in its appeal and offer much of interest and inspiration to railway purchasing, operating and mechanical officers, as well as to representatives of the coal industry. The division of the program into definite sessions, as shown in the following detailed schedule, will be helpful in enabling members and guests to attend the sessions in which they are most interested.

TUESDAY, MAY 8

General session

Meeting to convene at 11 a.m.

Invocation

Address by President J. E. Davenport, division superintendent, New York Central

Address by T. W. Evans, vice-president, Indiana Harbor Belt

Address by Samuel Weyer, consulting mining engineer

Technical session

Call to order at 2:30 p.m.

Report of Committee on Steam Turbine Locomotives

Report of Committee on Stationary Power Plants

Report of Committee on Diesel Locomotives

WEDNESDAY, MAY 9

Operating session

Call to order at 9:30 a.m.

Address by Col. F. W. Green, vice-president, St. Louis Southwestern

"Influence of commodities on fuel," paper by Dr. J. H. Parmalee, director, Bureau of Railway Economics, American Railway Association

Report of Committee on Fuel Bulletins

"Roller bearings in relation to fuel economy," paper by K. F. Nystrom, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific

Firing practice session

Call to order at 2 p.m.

Report of Committee on Locomotive Firing Practice and discussion

THURSDAY, MAY 10

Mechanical session

Call to order at 9:30 a.m.

Address by W. L. Bean, mechanical manager, New York, New Haven & Hartford

"The possibilities of future locomotive design," paper by W. E. Woodard, vice-president, Lima Locomotive Works.

"The locomotive of today and the future as a factor in fuel economy," paper by A. W. Bruce, designing engineer, American Locomotive Company

"Combustion in locomotive boilers," paper by Lawford Fry, metallurgical engineer, Standard Steel Works Company.

Mechanical session

Call to order at 2 p.m.

Address by A. G. Pack, chief inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission

Report of Committee on New Locomotive Economy Devices

Report of Committee on Front Ends, Grates and Ash Pans

FRIDAY, MAY 11

Fuel supply session

Call to order at 9:30 a.m.

Address by E. L. Mahan, president, National Coal Association

Report of Committee on Fuel Stations

Report of Committee on Accounting, Distribution and Statistics

Report of Committee on Inspection, Preparation and Analysis of Fuel

Business session

Call to order at close of fuel supply session, or at 2 p.m.

Report of Committee on Constitution and By-Laws

Election of Officers

Report of Secretary-Treasurer

Report of Auditing Committee

Adjournment

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—T. L. Burton, 165 Broadway, New York. Next meeting May 1-4, Book-Cadillac hotel, Detroit, Mich.

AMERICAN RAILWAY ASSOCIATION DIVISION C.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 20 to 27, 1928, inclusive, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting Windsor hotel, Montreal, September 11-13.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Next meeting June 20-22, Atlantic City, N. J.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-nines St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting June 25-29, Chalfonte-Haddon hotel, Atlantic City, N. J.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting, October 23-26, Hotel Sherman, Chicago.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Regular meeting second Monday in each month, except June, July and August. Great Northern Hotel, Chicago. Next meeting May 14, 8 p. m. Paper on co-operation between the car department and the transportation department will be read by F. J. Swanson, general car foreman, Chicago, Milwaukee & St. Paul, Louis, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—A. J. Walsh, 5874 Plymouth Apt. 18, St. Louis, Mo. Regular meeting first Tuesday in each month, except June, July and August, at Broadview Hotel, East St. Louis, Ill.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York. Regular meetings second Tuesday each month, except June, July and August, at Hotel Statler, Buffalo.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—(See Railway Car Department Officers' Association.)

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 3328 Beekman St., Cincinnati. Regular meeting second Tuesday, February, May, September and November.

CLEVELAND RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month, except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland. Next meeting May 7 at 8 p. m. A. F. Jensen, president Hanna Engineering Works, Chicago, will talk on "This is the age of riveted steel". Two reel moving picture showing rivets and their use.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Sherman, Chicago, August 21-22, 1928.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—L. G. Plant, Railway Exchange, 80 E. Jackson Boulevard, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention Hotel Sherman, Chicago, September 18-21, 1928.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, 3212 Delachaise street, New Orleans, La. Meetings third Thursday in each month.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York. Annual meeting Cleveland, Ohio, May 22-25.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September, Copley-Plaza Hotel, Boston.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Tuesday of each month in San Francisco and Oakland, Cal., alternately. Next meeting May 10, 7:30 p. m. Paper on detailed costs of yard operation will be read. Program being arranged by J. P. Quiley, superintendent of transportation, Western Pacific. Four or five papers by authorities on various phases of topic.

RAILWAY CAR DEPARTMENT OFFICERS' ASSOCIATION.—A. S. Sternberg, Belt railway, Clearing Station, Chicago.

RAILWAY CLUB OF GREENVILLE.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meeting third Thursday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, M. P. O. Drawer 24, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205 Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting third Thursday in November. Ansley Hotel, Atlanta, Ga.

SOUTHWEST MASTER CAR BUILDER'S AND SUPERVISORS' ASSOCIATION.—E. H. Weigman, master car builder, the Kansas City Southern, Pittsburg, Kan. Annual meeting August 4, 5 and 6 at Galveston, Tex.

TEXAS CAR FOREMEN'S ASSOCIATION.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings first Tuesday in each month. Terminal Hotel bldg., Fort Worth, Tex.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago, September 25 to 28 inclusive.

WESTERN RAILWAY CLUB.—W. J. Dickinson, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August. Next meeting May 7, Hotel Sherman, Chicago. Paper on aviation as a transportation agency will be presented by the Hon. W. P. McCracken, Jr., assistant superintendent of aeronautics, Department of Commerce, Washington, D. C. Annual dinner and meeting 6:30 p. m.

Supply Trade Notes

WILLIAM B. ROSS, manager of sales of Edwin S. Woods & Company, Chicago, has been elected vice-president in charge of sales.

HARRY FULTON, assistant comptroller of the American Locomotive Company, at New York, died at his home in New York on April 7.

JOHN PENN BROCK, general manager of the Lebanon plant of the Bethlehem Steel Company, died suddenly in Rome, Italy, on April 9.

JUSTIN G. SMEBY has been appointed welding engineer at the South Philadelphia works of the Westinghouse Electric & Manufacturing Company.

BRUCE P. OWENS, vice-president of the Central Valve Manufacturing Company, formerly the O'Malley-Beare Valve Corporation, died at his home in Wilmette, Ill., on March 30.

F. P. WALSH has been appointed manager of the crane department and R. H. Moore, manager of the foundry equipment department of the Whiting Corporation, Harvey, Ill.

PAUL WILLIS has been elected a vice president of the J. S. Coffin, Jr., Company, Jersey City, N. J., having resigned his position as district manager of the Franklin Railway Supply Company, Inc.

H. J. HAIR, until recently sales engineer, handling railroad sales for the Whiting Corporation, has been appointed manager of railroad sales of The Watson-Stillman Company, with his headquarters at the main office, New York.

C. E. PREBLE, who has had charge of the engineering department of the Heywood-Wakefield Company, at Wakefield, Mass., has been appointed assistant to Bertram Berry in the railway sales department at New York.

The W. & B. COMPANY, 1300 E. 92nd street, Chicago, has been organized to manufacture and sell a new electric alloy rolling side bearing for freight cars. H. F. Wardwell, has been elected president; W. A. Spuehler, vice-president, and C. Bladin, sales manager.

MARCUS CHASE, sales manager of the Niles-Bement-Pond Company at Boston, Mass., has resigned after 29 years of continuous service with this company. He is succeeded by M. S. Bradley who has been an assistant to Mr. Chase for nearly 15 years.

THE GRAHAM BOLT & NUT COMPANY, Pittsburgh, Pa., has opened a district office at 1 East Forty-second street, New York City, under the direction of W. K. Graham. Sales in the New England states as well as the Metropolitan district will be directed by this office.

E. M. CONVERSE has been appointed sales manager of the Dearborn Chemical Company, Chicago, to succeed W. A. Converse, secretary and chemical director, who has been director of sales in the stationary department and who will now devote more of his attention to matters of general company operation.

GAETANO LANZA, formerly a special consultant in mechanics at the Baldwin Locomotive Works, Philadelphia, Pa., died recently at his home in Philadelphia, at the age of 79 years. Mr. Lanza was a member of the American Society for Testing Materials and the author of "Applied Mechanics" and "The Dynamics of Machinery."

THE COLUMBUS MCKINNON CHAIN COMPANY, Tonawanda, N. Y., has acquired control of the hoist division of the Chisholm-Moore Mfg. Company, Cleveland, Ohio. The general sales offices and factory will continue to operate at Cleveland

under the same name as in the past. The personnel of the organization as a whole will remain the same.

THE WRIGHT MANUFACTURING COMPANY, Lisbon, Ohio, manufacturers of chain hoists, trolleys and cranes, has sold its business and trade name to the American Chain Company, Inc., Bridgeport, Conn. There is no anticipated change in policies or sales organization of the Wright Manufacturing Company. H. F. Wright and W. F. Wright will continue in their respective divisions of sales and production of Wright products.

FRANK H. MALONEY, co-manager of the San Francisco office of the Truscon Steel Company, Youngstown, Ohio, has been promoted to district manager with headquarters at St. Louis, Mo. Richard W. Maloney, representative at San Francisco has been transferred to St. Louis as representative for Southern Illinois. The St. Louis office has been moved from the Syndicate Trust building to 1304, Ambassador building.

H. W. DILLON, formerly sales engineer of the Chicago Pneumatic Tool Company, is now sales engineer of the Gold Car Heating & Lighting Company, with headquarters at Brooklyn, N. Y. J. P. Rapp, formerly with the Standard Steel Car Company and who had served as inspector of the American International Shipbuilding Corporation, is now with the Gold Car Heating & Lighting Company in its eastern sales department, Brooklyn.

H. D. SAVAGE, for many years vice-president, has been elected president of the Combustion Engineering Corporation, New York, an American subsidiary of International Combustion Engineering Corporation, succeeding Joseph V. Santry, who has resigned. George T. Ladd, president of the Ladd Water Tube Boiler Company and president of the Heine Boiler Company, has been elected vice-chairman of the board of directors of the Combustion Engineering Corporation.

R. F. DEMOTT has been appointed district manager of the Franklin Railway Supply Company, Inc., with headquarters at St. Paul, Minn. Mr. DeMott entered railway service as a machinist helper, in 1903, with the Atchison, Topeka & Santa Fe. He was later promoted to engineman and then went in the same capacity with the Colorado & Wyoming. Mr. DeMott entered the service department of the Franklin Railway Supply Company, Inc., in November, 1918, since which time he has been assigned to the western territory.

LEEDS, TOZZER & COMPANY, INC., New York, has been appointed representative of the tramrail system in Manhattan, Bronx and Staten Island, New York, for the Cleveland electric tramrail division of the Cleveland Crane & Engineering Company, Wickliffe, Ohio, and distributor to the railroad field of the line of Stuebing-Cowan, hand and electric lift trucks and steel bound platforms. Wm. McCormick, formerly Pittsburgh sales manager of the Niles Tool Works and the Pratt & Whitney Company, is now western sales manager of Leeds, Tozzer & Company.

THE HAMMOND BOLT AND NUT COMPANY, Chicago, has been organized to take over the manufacture of bolts and nuts formerly conducted by the Illinois Car and Manufacturing Company. M. J. McDonough, vice-president of the Illinois Car and Manufacturing Company has been elected president of the new company; E. M. Joyce, assistant to the superintendent of the Illinois Car and Manufacturing Company has been elected vice-president and M. L. Hunt, treasurer and purchasing agent of the old company and Charles Aaron, secretary, will occupy the same positions with the newly formed company.

WILLIAM STUART AUCHINCLOSS, formerly engaged in the manufacture of railroad cars, died on April 10 at his home at Atlantic Highlands, N. J., at the age of 86. After his graduation from Rensselaer Polytechnic Institute in 1862, he served for six years in the construction department of the Atlantic & Great Western, now a part of the Erie, and with the Jersey City Locomotive Works. From 1871 to 1879 he was engaged in the manufacture of railroad cars. Mr. Auchincloss was an inventor and wrote several books, including one on Link and Valve Motions.

DONALD M. RYERSON, vice-president and general manager of Joseph T. Ryerson & Son, Inc., has been elected chairman of the board of directors, succeeding his father, Edward L. Ryerson, Sr. deceased. Edward L. Ryerson, Jr., vice-president in charge of plant operations and several sales divisions, succeeds his brother, Donald Ryerson, as vice-president and general manager. Everett D. Graff has been elected a vice-president in charge of purchases. Mr. Graff joined the Ryerson organization upon graduation from college in 1906. In 1926 he was appointed assistant to the vice-president in charge of purchases.

THE LARKIN PACKER COMPANY, St. Louis, Mo., has purchased outright all of the property and entire assets of the Davis Boring Tool Company, Inc. Tentative plans call for the separate operation of both plants, with the Davis Boring Tool Company preserving its identity as a division of the Larkin Packer Company, with works at its present location, 3693 Forest Park Boulevard. General offices will be maintained at the Larkin Plant, 6200 Maple Avenue. J. J. Larkin will be the active head of both concerns, and J. E. Kilzer, who was instrumental in developing the improved Larkin expansion boring bar, will continue as assistant general manager in charge of operations.

JOHN G. PLATT, vice-president of the Hunt-Spiller Manufacturing Corporation, Boston, Mass., has been elected president and general manager, succeeding Walter B. Leach, deceased. Victor W. Ellet has been elected vice-president and F. J. Fuller succeeds Mr. Ellet as sales manager. Mr. Platt was born at Zanesville, Ohio, on February 11, 1874. Five years later his parents moved to Baltimore, Md., and he was educated in the public schools of that city. He entered railway service at an early age as a messenger for the Baltimore & Ohio. In January 1890, he became an apprentice in the locomotive department of the same railroad, entering the drafting room as a locomotive draftsman in 1894. On February 1, 1901, he was transferred to Newark, Ohio, as chief draftsman of the Baltimore & Ohio, Lines West. On December 20, 1902, he left the Baltimore & Ohio to become assistant to the master mechanic of the Erie at Jersey City, N. J. He was transferred to Meadville, Pa., in April, 1903, as engineer of tests serving in that capacity for several years. On February 1, 1907, he left railway service to become master mechanic of the Franklin Branch of the American Steel Foundry, in which position he remained until June 1 of the same year, when he entered the service of the Hunt-Spiller Manufacturing Corporation as mechanical representative. On June 1, 1912 he was appointed sales manager and on March 14, 1917, was appointed vice-president.

Trade Publications

WELDING SUPPLIES.—Supplies for the Lincoln "Stable-Arc" welder are described in the 8-page bulletin of the Lincoln Electric Company, Cleveland, Ohio.

BOWSER AUTOMATIC BARRELING SYSTEM.—The Bowser method for filling drums at railroad oil houses is illustrated in a four-page folder issued by S. F. Bowser & Co., Fort Wayne, Ind.

ELECTRICAL WELDING PRESS.—A photograph and brief description of the Gibb electric welding press is contained in the bulletin of the Gibb Welding Machines Company, Bay City, Mich. This is Bulletin No. 60.

ARC-WELDED STEEL STORAGE RACKS.—The construction plan of arc-welded steel storage racks, and the floor plan of a typical installation are shown in the four-page illustrated bulletin of the Lewis-Shepard Company, 134 Walnut street, Boston, Mass. Barrels, boxes, bales, crates, or containers stored in these racks are easily and quickly available.

REVERSE BLAST OIL BURNER.—Catalogue sheet No. 550A issued by the Johnston Manufacturing Company, 2825 East Hennepin avenue, Minneapolis, Minn., illustrates a reverse blast low pressure burner for forging, welding, forming, annealing, heat treating and soft metal melting furnaces and blacksmith forges.

CUTTER GRINDER.—Bulletin No. 48 of the Ingersoll Milling Machine Company, Rockford, Ill., contains an illustrated description of a new Ingersoll cutter grinder and a chart giving the recommended angles and clearances for grinding Ingersoll face milling cutters for milling the average run of work when the spindle is perpendicular to the finished surface.

STEPTOE SHAPERS.—The complete line of Steptoe shapers is described and illustrated by the Western Machine Tool Works, Holland, Mich., in its 20-page catalogue No. 30. The application of Timken tapered roller bearings to these machines is clearly shown in cross-sectional drawings.

PNEUMATIC TOOLS AND APPLIANCES.—A complete line of pneumatic tools and appliances, including chippers, riveters, drills, grinders and saws, hoists, etc., is covered in the numerous bulletins which have been bound in catalogue form by the Ingersoll-Rand Company, 11 Broadway, New York.

GRINDERS.—Helpful hints for the care and use of twist drills are contained in the Grinder Book of the Grand Rapids Grinding Machine Company, Grand Rapids, Mich., which illustrates and describes in detail the constructional features of the Grand Rapids drill, cutter and tool, and tap grinders.

AIR HOISTS.—Catalogue No. 15, issued by the Hanna Engineering Works, 1765 Elston Avenue, Chicago, describes the Hanna pneumatic cylinder hoist which may either be used portably by being suspended from an I-beam trolley running on an overhead rail, or mounted in a fixed position.

WOODWORKING MACHINERY.—The Yates-American Machine Company, Beloit, Wis., in the first edition of its catalogue of woodworking machinery illustrates and describes approximately 300 machines particularly adapted for planing and saw mills, box, sash and door factories and railroad and car shops.

PUNCHES AND SHEARS.—A general description of Covington vertical punches and shears is given in bulletin 14A issued by the Covington Machine Company, Inc., Covington, Va. A few representative horizontal punching and bending machines also are shown.

GOOD WELDING ESSENTIALS.—For the benefit of those individuals or companies not thoroughly familiar with the art of arc welding, the Wilson, Welder & Metals Company, Wilson Building, Hoboken, N. J., presents in Bulletin E a non-technical discussion of good welding essentials as prepared by its technical director, Alexander Churchward.

NITRALLOY AND THE NITRIDING PROCESS.—The Ludlum Steel Company, Watervliet, New York, has issued a bulletin in which is contained information pertaining to nitralloy and the methods and equipment used for the nitriding process. The bulletin contains data in the form of tables, plotted curves, and photographs which have been obtained by much experimental work.

MILLING MACHINES.—A general description of the operation of three types of Ingersoll milling machines—the inclined rail, the adjustable rotary, and the adjustable rail—is contained in bulletin No. 46 issued by the Ingersoll Milling Machine Company, Rockford, Ill. Bulletin No. 47 depicts the more common types of Ingersolls and some of the operations for which they are used.

SPEED REDUCERS.—The Albaugh-Dover Manufacturing Company, 2100 Marshall boulevard, Chicago, gives in Bulletin "A" complete information on high efficiency speed reducers. These speed reducers are applicable for drives to conveyors, hoists, stokers, grinders, machine tools, and other equipment that must run at slower speeds than electric motors or similar sources of power.

Personal Mention

General

ELIOT SUMNER, superintendent of motive power of the Pennsylvania with headquarters at New York, has been appointed assistant to the general superintendent of motive power of the Eastern region.

H. J. HADDEN, purchasing agent of the Chicago, Springfield & St. Louis and the Jacksonville & Havana, at Springfield, Ill., has been appointed assistant to the general manager with headquarters at the same point.

B. P. JOHNSON, who has been promoted to mechanical superintendent of the lines of the Northern Pacific east of Paradise, Mont., has completed nearly 40 years of railway service, all with the Northern Pacific.



B. P. Johnson

He was born on October 1, 1869, at Mt. Holly, N. J., and after attending grade school in Camden, N. J., served a five-year apprenticeship as machinist in jobbing shops at Philadelphia, Pa., and Camden. Mr. Johnson entered railway service on the Northern Pacific on December 20, 1888, as a roundhouse laborer at Glendive, Mont. A year later he became locomotive fireman and served at Glendive in that capacity and as a locomotive engineman until September 1, 1903, when he was promoted

to road foreman of engines at the same point. On April 1, 1908, he was appointed master mechanic at Glendive, where remained until January 15, 1916, when he was transferred to Seattle, Wash. Mr. Johnson was promoted to general master mechanic of the lines of the Northern Pacific between Mandan, N. D., and Paradise, Mont., with headquarters at Livingston, Mont., on June 15, 1923, and his advancement to mechanical superintendent became effective on March 15.

BRUCE M. SWOPE, master mechanic of the Pennsylvania at Columbus, O., has been appointed superintendent of motive power, Central Pennsylvania division, with headquarters at Williamsport, Pa. Mr. Swope was born on June 13, 1885, at Altoona, Pa. He was graduated in mechanical engineering from Lehigh University in 1907. On July 1, 1908, he entered the service of the Pennsylvania as a special apprentice at Altoona, Pa. In 1912 he was appointed motive power inspector, Conemaugh division, and later served in the same capacity at the Pitcairn car shop, Pittsburgh division. In 1916 he was assigned to special work in the office of the superintendent of motive

Bruce M. Swope

power, Western Pennsylvania division, at Pittsburgh, Pa. In 1917 he was promoted to assistant master mechanic at Renovo,

Pa.; in 1920 to assistant engineer of motive power, Lake division, Cleveland, O.; in May, 1923, to assistant engineer motive power, Southwestern region, office of general superintendent motive power, St. Louis, Mo.; in February, 1924, to master mechanic, St. Louis division, with headquarters at Terre Haute, Ind., and in November, 1924, to master mechanic, Buffalo division, with headquarters at Olean, N. Y. He was transferred to Columbus, O., on March 1, 1927, as master mechanic, serving in this capacity until the time of his recent appointment to superintendent of motive power.

E. B. DEVILBISS, superintendent of motive power of the Pennsylvania, with headquarters at Williamsport, Pa., has been appointed superintendent of motive power of the New Jersey division.

Master Mechanics and Road Foremen

F. T. HUSTON, master mechanic of the Renovo division of the Pennsylvania at Erie, Pa., has been transferred to the Panhandle division, with headquarters at Dennison, Ohio.

L. B. JONES, master mechanic on the Eastern region of the Pennsylvania at Harrisburg, Pa., has been transferred to the Columbus division with headquarters at Columbus, O., succeeding B. M. Swope.

P. M. CHESSMAN, master mechanic of the Pennsylvania assigned to special duty in the office of the general superintendent of motive power of the Western region at Chicago, has been transferred to the Monongahela division with headquarters at Uniontown, Pa.

D. C. ELLIOTT, rules instructor on the Belleville division of the Canadian National, has been promoted to master mechanic of the Hornepayne division, with headquarters at Hornepayne, Ont., succeeding J. Hawkins.

J. HAWKINS, master mechanic of the Hornepayne division of the Canadian National, at Hornepayne, Ont., has been transferred to the Belleville division, with headquarters at Belleville, Ont. Mr. Hawkins replaces N. M. Kerr.

N. M. KERR, master mechanic of the Belleville division of the Canadian National at Belleville, Ont., has been transferred to the St. Lawrence division with headquarters at Montreal, Que.

GUY F. EGBERS, who has been promoted to general master mechanic of the Central district of the Northern Pacific, with jurisdiction extending from Mandan, N. D., to Paradise, Mont., and headquarters at Livingston, Mont., has completed nearly 41 years in the service of that railroad. He was born on January 6, 1869, at Carthage, Ill., and entered railway service at the age of 18 years as a fireman and hostler on the Northern Pacific. Mr. Egbers was advanced to engineman on the Idaho division in September, 1890, being promoted to road foreman of engines of that division on September 1, 1904. In May, 1907, with the creation of the Pasco division, he was promoted to assistant



Guy F. Egbers

master mechanic, with headquarters at Pasco, Wash., where he remained until 1909 when he was further promoted to master mechanic of that division. On September 3, 1917, Mr. Egbers joined the Russian Railway Service Corps, serving with that

unit in Siberia until October, 1919, when he reentered the service of the Northern Pacific as master mechanic of the Idaho division, with headquarters at Spokane, Wash. Mr. Egbers was holding this position at the time of his promotion to general master mechanic.

CARLETON K. STEINS, who has been appointed master mechanic of the Pennsylvania, with headquarters at Indianapolis, Ind., was born on February 21, 1891, at East Orange, N. J. He is a mechanical engineer graduate of Stevens Institute of Technology, Class of 1913. In July of the same year he entered the Altoona Works of the Pennsylvania as a special apprentice. In 1917 he was commissioned first lieutenant in the 19th Engineers Railway, U. S. Army. After 19 months service in French railway shops, he returned to the Pennsylvania in 1919. From that time until his appointment as master mechanic at Indianapolis, he was employed successively as assistant master mechanic, Meadows shops; assistant engineer motive power, New Jersey division; assistant master mechanic, Philadelphia division, Harrisburg, Pa., and assistant engineer motive power, Eastern Region. He was appointed to the latter position in September, 1926.

Stores Department

H. WEINDEL has been appointed stores inspector of the Union Pacific, with headquarters at Omaha, Neb.

E. F. MCFADDEN, storekeeper of the Union Pacific at Green River, Wyo., has been promoted to assistant division storekeeper succeeding C. W. Craig.

H. L. CUNNINGHAM has been appointed purchasing agent of the Midland Valley and the Kansas, Oklahoma & Gulf, with headquarters at Muskogee, Okla.

W. N. STRONG, storekeeper of the Chesapeake & Ohio, at Cane Fork, W. Va., has been transferred in the same capacity to Roncverte, W. Va., succeeding T. C. Sydnor, resigned.

C. S. WETHERHOLT has been appointed storekeeper of the Chesapeake & Ohio, with headquarters at Cane Fork, W. Va., succeeding W. N. Strong.

W. T. CAPPS has been appointed stoker supervisor of the Baltimore & Ohio, with headquarters at Baltimore, Md. Mr. Capps was formerly mechanical expert of the Locomotive Stoker Company.

C. C. McMILLEN, storekeeper of the Walbridge Road car department of the Ohio Central lines of the New York Central at Toledo, Ohio, has been promoted to assistant division storekeeper, with headquarters at Bucyrus, Ohio.

J. E. McMAHON, general storekeeper of the Chicago, St. Paul, Minneapolis & Omaha at St. Paul, Minn., has been promoted to assistant purchasing agent and general storekeeper, with headquarters in the same city.

JOHN BALL, assistant purchasing agent of the Chicago & North Western at Chicago, has been promoted to assistant general purchasing agent of that railroad and the Chicago, St. Paul, Minneapolis & Omaha, with headquarters as before at Chicago.

BENJAMIN D. NOETZEL, assistant purchasing agent of the Copper Range, has been promoted to purchasing agent, with headquarters as before at Houghton, Mich. He succeeds John M. Wagner who has been transferred to the executive department of the Copper Range.

C. W. CRAIG, assistant division storekeeper of the Union Pacific at Green River, Wyo., has been promoted to division storekeeper of the Central division of that railroad and the St. Joseph & Grand Island, with headquarters at St. Joseph, Mo., succeeding H. Weindel.

Obituary

PHILIP J. DOHERTY, chief attorney of the division of safety of the Interstate Commerce Commission, died on April 13, after a month's illness. Mr. Doherty was 72 years of age.

FREDERICK G. PREST, who retired as director of purchases of the Northern Pacific in 1924, died at his home at St. Paul, Minn., on March 30 after an illness of less than a day.

Mr. Prest was born on January 5, 1854, at Queenston, Ont., and entered railway service as a clerk in the purchasing department of the Northern Pacific in 1880. In 1882, he was advanced to chief clerk of that department at St. Paul, being promoted to assistant purchasing agent, with headquarters at the same point, nine years later. He was further promoted to purchasing agent in 1896, remaining in that position for 25 years, until his promotion to director of purchases in November, 1921.

HENRY H. WILSON, assistant to the mechanical superintendent of the Boston & Maine, with headquarters at Boston, Mass., died suddenly on March 7 in a hospital at Concord, N. H. Mr. Wilson was 64 years of age.

JOSEPH H. MCCONNELL, superintendent of motive power and machinery of the Union Pacific from 1891 to 1901, died at Santa Barbara, Cal., on April 4, in his eighty-fifth year. Mr. McConnell was born at Elmira, N. Y., on September 29, 1843, and entered railway service in 1861 as a machinist apprentice on the Great Western (now the Wabash) at Springfield, Ill. For the next 25 years he served in that capacity, as a machinist on the Chicago, Burlington & Quincy at Galesburg, Ill., and on the Chicago & Alton at Jacksonville, Ill., as general foreman of the Omaha (Neb.) shops of the Union Pacific, and as master mechanic of the Nebraska division of the Union Pacific. In 1886 Mr. McConnell left railroad service to engage in the mercantile business at Omaha, returning to the mechanical department of the Union Pacific two years later. He was promoted to superintendent of motive power and machinery, with headquarters at Omaha, in February, 1891, where he remained until July, 1901, when he was appointed manager of the Pittsburgh (Pa.) works of the American Locomotive Company. Mr. McConnell left the service of that company on October 1, 1903, locating in Santa Barbara in 1921.

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View of a 1500-ton hydraulic press, (Berwick, Pa., plant) shown at the American Car & Foundry meeting of the New York Railroad Club, March 16, 1928